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The Public Lighting Tables of the American Meter Company will be found in the page advertisement of that Company.

CONTENTS.

An Asterisk (*) denotes an illustrated article.

EDITORIALS—
Briefly Told 617
An Educative Visit, Let Us Hope—In Memoriam—The Proceedings, American Gas Institute—A Personal and a Bit of History—Current Comment.
*A German Gas Turbine 618
Plain Talks on Illuminating Engineering.—With the Consumer, by Mr. E. L. Elliott 619
Schemes for Increasing Business, by Mr. J. G. Learned 621
*Röntgen, Cathode and Positive Rays, by Prof. J. J. Thomson, F.R.S. 622
Plan and Scope of the Illuminating Provision, Building of the Engineering Societies 624
Reducing Dust and Hardening Roads by Surface Application.—Concluded from Page 583 624
*Asphaltic Dripped, Roller Compressed Road Making in Santa Monica, Cal 625
A Texas Bill Respecting Oil and Petroleum Products 626
The Progress of Electrical Illumination, by Mr. J. W. Cowles 627
Aids to Progress in Lighting 628
Recent Patent Issues 628
ITEMS OF INTEREST FROM VARIOUS LOCALITIES 629
The Easthampton (Mass.) Company's New Showroom—Personal—Mr. Smart's Trouble—Betterments at San Diego, Cal.—Death of Mr. R. W. Deeble—Strike at Louisville, Ky.—Three Personals—Annual Meeting, Cadillac, Mich.—A Bad Fire—Personal—A Handsome Booklet—And It was Snowing—Death of Mr. Oscar Edwards—Original Capt. McGregor—Contract for the Gas Bench Construction Company—Home Again—A Colored Thief Goes Away—An Enjoyable Affair—Two Personals—Mrs. Helen Armstrong is on the Job—Personal—An Annual Meeting—Another Municipal Failure—A New Office for the Welsbach Company, Providence, R. I.—And Many Other Items.
The Market for Gas Securities 631

BRIEFLY TOLD.

AN EDUCATIVE VISIT, LET US HOPE.—About a fortnight ago the Municipal Club, of New York city, made an "official visit" to the works of the Astoria Light, Heat and Power Company, now partly completed at Woolsey's Point, Astoria, L. I.—we take it for granted that this Company is owned and controlled by the Consolidated Gas Company, of Manhattan, is well-known, and that its plant is in a fairly forward state of construction. The Club is a sort of self-constituted poking in-and-out-of affair, whose incentive is to tell people not its members that which is good for the taxpayers and rentors of New York city, in so far as this civic management is concerned. It has several committees, of course, and one of these is that on Laws and Corporate Rights. The Chairman of this Committee is Mr. Frederick Gunnison, and Mr. Gunnison is also Chairman of the New York State Commission of Gas and Electricity. As a member of the Club he visited, as before noted, the huge piles of stone, brick, concrete and iron that are underway for the best needs of the noted Company. To make a long story as short as possible, the distinguished visitor and his associates were tugged to the works, were received by Mr. Addicks and his confreres, and were shown over the vast belongings of the Company. In the evening the inspectors and many of the inspected were the guests of the Company at a dinner in Manhattan, and amongst other things they listened to an excellent speech by Dr. A. H. Elliott, who reviewed in his concise and intelligent way the manufacture of gas, and many other things which follow its distribution. We hope and believe that the visit in its entirety was provocative of an educational tendency, and we know now to a certainty that at least one of the Commissioners has been through at least two gas plants. Neither Dr. Marks, Prof. Bemis nor Mr. Adams was present.

IN MEMORIAM.—With exceeding sorrow we have to chronicle the sad bereavements which have befallen two of the fraternity. The first of these blows came to Mr. Carl H. Graf, General Manager of the Indianapolis (Ind.) Gas Company, whose estimable wife, Caroline Battel, passed away at her home in Indianapolis, the morning of the 1st inst. Born in Providence, R. I, September 7th, 1870, she was united in marriage to Mr. Carl H. Graf, in 1901. She had been ill from tuberculosis of the lungs, but it was thought her removing to the West would effect a permanent cure. A severe attack of the grip sustained late this fall, however, eventuated in her death. The remains were interred in Newark, N. J. Two daughters (Madeline and Eleanor) survive her. The other sorely-afflicted one is Mr. Alfred G. Lloyd, Secretary of the Lloyd Construction Company, whose wife was suddenly stricken the 8th inst. in such a way that death could hit no harder blow. Youthful, beautiful, talented and sweetly feminine, the summoner who respects none, who gathers all, could not have seemed harsher in his dread work. Deceased was Miss Janie Lachicotte, and in her parents' home, Waverly Mills, S. C., scarce a twelvemonth ago, she became the wife of Mr. Lloyd, under circumstances that were guarantees of a long and happy wedded life. Interment was made in the Lachicotte family plot in the quaintly beautiful cemetery of Waverly Mills. *Jure Divino.*

THE "PROCEEDINGS," AMERICAN GAS INSTITUTE.—Before us is the First Volume of the Proceedings of the American Gas Institute, which duly chronicles the records of the Institute's first annual meeting, held last October in Chicago. It is complete in every particular, and is a shining testimonial to the application of that veteran of Secretaries, Mr. James W. Dunbar, of New Albany, Ind. It is no small feat to edit and put out a book such as the Volume surely is—well over 1,000 pages are between its covers; but a carper he indeed will be who chances to utter a word in derogation of the style and finish that mark it as a fact accomplished.

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A Personal and a Bit of History.—Mr. R. M. Searle, General Manager of the Rochester (N. Y.) Railway and Light Company, will read a paper on the development of high pressure gas distribution in the United States, at the June meeting of the British Institution of Gas Engineers, which is to be convened in Dublin, Ireland, the 18th of the named month. Mr. Searle, of course, will visit the Giant's Causeway, the electric tramway taking him thereto from Port Rush, and on his way to Dublin will likely have a look in at Cork, not far from which tidy town he may pay his respects to the famous stone that lies not far from "Killarney's lakes and fells." An interesting bit of history respecting Port Rush might here be retold. It has to do with the first tramway of the electric type that was ever operated commercially in the world. This tramway, which is of the third rail type, in fact the counterpart of the system that prevails to-day in the New York city subway, was constructed by Mr. H. W. Trayle, who had large vested interests in the Causeway and its surroundings, in order to facilitate the carrying from and to Port Rush of the pilgrims to the Causeway—the roads were very rough and circuitous between the named points. The road was put into operation in the summer of 1879, and it has been a success commercially. A brother of the writer travelled over it in August of that year, and quite a recent patron of it was Mr. W. J. Logan, of the Logan Iron Works.

CURRENT COMMENT.—

The Committee of experts, comprising Dr. Alexander C. Humphreys, President of the Stevens Institute of Technology; R. M. Searle, General Manager of the Rochester (N. Y.) Railway and Light Company; and A. E. Forstall, of Montclair, N. J., named by the New State Commission of Gas, Water and Electricity, to report a scheme for the establishing of a standard of candle power to rule through the State of New York, has, to put it briefly, recommended that the values be thus standardized: Coal gas, 15-candle power; water gas, 19-candle power; mixed gas, 17 candles. Neither Dr. Marks, Prof. Bemis nor Mr. Adams was consulted in the preliminary, in the counselling nor in the findings.

The Citizens Gas Company, of Jacksonville, Fla., will make many main extensions this summer. In fact, it is proposed to pipe the places known as Springfield, La Villa, Fairfield and Riverside. This means the putting down of 10 miles of pipe, which can be readily strung in and along, provision for such extension having been made by Mr. Lewis J. Carder a few years ago, or when the new plant at Jacksonville was put in commission.

Mr. M. J. Kinch has been appointed General Superintendent of the Green Bay (Wis.) Traction Company, and of the Green Bay Gas and Electric Company, vice Mr. Howard Bixby, resigned.

Mr. J. L. Esperance has been named to take charge of the commercial branch of the business of the Saginaw City (Mich.) Gas Company.

At the annual meeting of the Utica (N. Y.) Gas and Electric Company, the following Directors were chosen: Anthony N. Brady, W. E. Lewis, Jno. C. Brady, S. A. Beardsley, W. T. Baker, Chas. B. Rogers, John F. Maynard, Chas. S. Symonds and M. J. Brayton.

We are indebted to the *Gas World* for the sad knowledge of the death of Mr. Marcelin Berthelot, the founder of thermo-chemistry and perhaps the greatest chemist of the 19th century, who passed away in Paris, Monday, the 8th inst., under pathetic circumstances. His wife, who had been practically an invalid for some years past, had recently become critically ill, and M. Berthelot, who was deeply attached to her, suffered acutely. On Monday afternoon he attended a sitting of the Academy of Science, and on returning went at once to his wife's bedside. She was very ill, and the Professor, greatly distressed, remarked to his sons that he thought her death would kill him too. He was persuaded, however, that a fatal issue was not imminent, and retired to his study. In a few minutes an excited servant rushed in to tell him that Madame Berthelot was dying. He rose quickly to go to her room, but sank back in his chair, and when an effort was made to raise him it was found that he had died almost at the same instant as his wife.

At the meeting of the New York Section of the Illuminating Engineering Society, held at 8:15 P.M., Friday, April 12, in the Edison Auditorium, 44 West 27th street, New York city, the following subjects were discussed:

1. Standards of light, primary and secondary.
2. Comparative rating of inverted and upright gas lamps.
3. Is it ever desirable to mix different colors of light and kinds of illuminants in store lighting?
4. To what extent in practice can the distribution of light about a lamp be modified by reflectors or globes?

There was an excellent attendance, and the proceedings were very interesting.

A German Gas Turbine.

Mr. Frank C. Peters, writing to the *Gas Engine*, says: With the wonderful development of the steam turbine and the internal combustion engine during the past decade, these types of prime movers proving formidable rivals to the reciprocating steam engine, considerable attention has been paid to the design and construction of a combination of the two, resulting in a gas turbine retaining the advantages without the disadvantages of the steam turbine and the gas engine.

The accompanying illustration, Fig. 1, and drawings, Figs. 2 and 3,

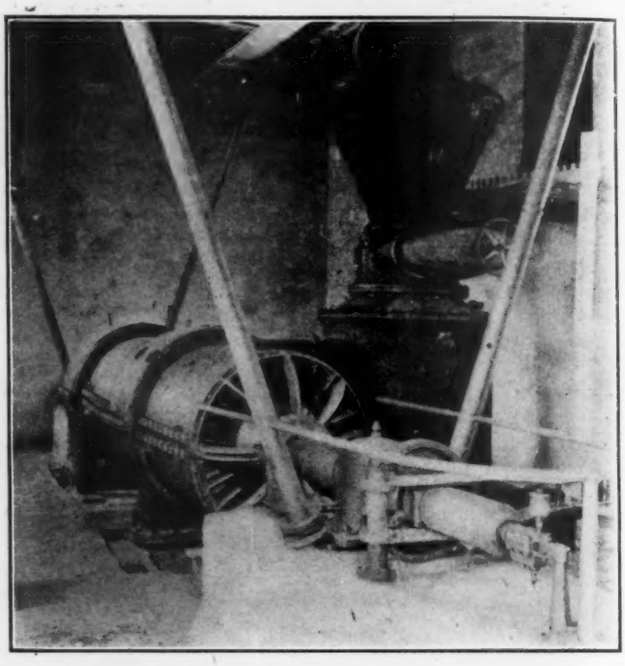


Fig. 1.

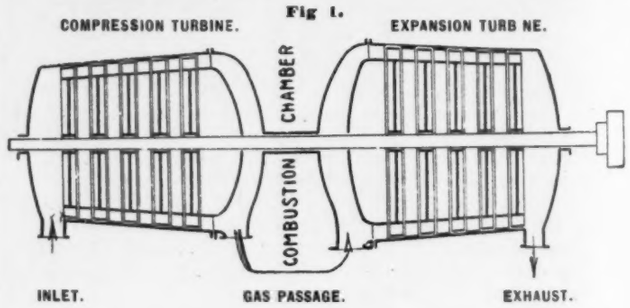


Fig. 2.

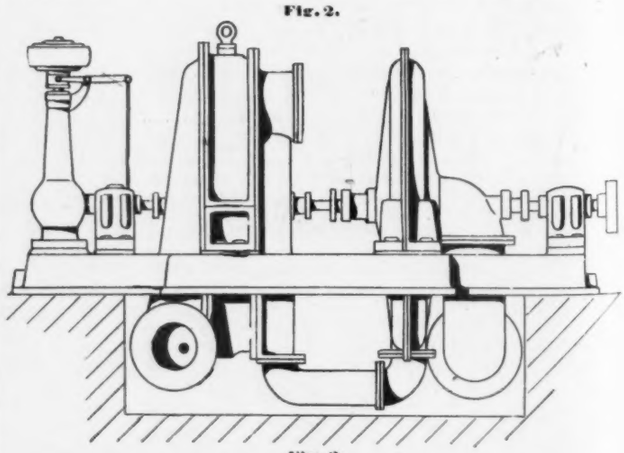


Fig. 3.

show the details of construction of the German gas turbine designed by Dr. Stolze, of Charlottenburg. A 200-horse power turbine of this construction is being installed at Berlin Weissensee by the Gas Turbine Gesellschaft Stolze. It is stated that Herr Redtenbacher first conceived the idea that the most efficient hot air motor would be a gas turbine, as the Carnot cycle is more nearly approached by this type of

prime mover than by any other form of engine designed. Only the up-to-date machine shop methods and construction make it possible to construct a successful gas turbine which necessitates the use of extremely high angular speed. The gas turbine, it is claimed, will not only have much higher efficiency than the steam turbine or the gas engine, but will have in its construction and operation many of the individual advantages of each of these modern forms of engines.

A thoroughly successful gas turbine would not only be of small size for a given output, but could be maintained at practically a constant speed with the same low first cost for electrical generators as is found to be so desirable with steam turbines. There is every reason to believe that the gas turbine should also be utilized to advantage not only in the electric power houses of iron and steel plants, using the waste blast furnace gases, but also in coal mining districts, where the waste gases from coke ovens can be utilized to advantage.

As the experiments already made with the gas turbines have shown that either illuminating gas or natural gas can be utilized to advantage as well as producer gas, there should be a great field of application for this motor in electric central station service. It has also been demonstrated that alcohol or gasoline vapors, as well as benzine and carbonated air, can be used equally as well as producer gas, and this should open a wide field of usefulness for the gas turbine for the propulsion of motor boats.

As will be noted by the accompanying drawings and illustrations the Stolze gas turbine consists of a compression turbine and an expansion turbine, the combustion chamber being located between the two. There are two sets of turbine vanes mounted on a common axle, these vanes or blades being of such construction that one set acts as an air compressor while the other set is driven by the expanding heated air operating as a motor.

The gas turbine is constructed along similar lines to the steam turbine, there being a number of rows of guiding vanes fixed to the engine casing and a similar number of rows of running turbine blades mounted on a common rotating cone fastened to the common shaft and turning with the same, the gases entering the inlet of the compression turbine passing through the combustion chamber into the expansion turbine and passing out of the exhaust outlet of the latter. The set of turbine blades in the compression turbine draw in the fresh air and compress it up to a given pressure, being heated with the exhaust gases by means of a preheater. It is conveyed into a chamber lined with fireproofing material, a small portion being conveyed through the grate of a producer, where it gasifies a convenient form of fuel. The gas thus formed passes into the chamber above referred to and is consumed by the compressed air, evolving enormous amounts of heat as it is burned to carbonic acid and water vapor. These gases are then allowed to penetrate into the second turbine system or expansion turbine, where they yield useful work in traversing the various steps by expansion.

It will thus be seen that the operation of the gas turbine is similar to the characteristic cycles of all internal conbustion engines, except that the combustion takes place after compression in direct opposition to the working cycles of most forms of gas engines.

On account of the increase of volume resulting from the heating there is an excess of work performed over and above the absorbed energy, and it is claimed that the efficiency of the perfected gas turbine will without doubt be susceptible of being raised far above that of the reciprocating steam engine, the highly efficient reciprocating gas engine, and the economical steam turbine as operated with highly superheated steam.

Plain Talks on Illuminating Engineering.—With the Consumer.[1]

By Mr. E. L. Elliott.

We have thus far discussed various objects pertaining to illumination from the engineering standpoint, having in view more particularly the interests of those who are seeking technical information on this new branch of science. In this issue we will vary the theme and have a brief talk directly with the user of light.

Sight is the most precious of the senses, and yet it is one which is probably more frequently abused than any other. It is strained and overworked until nature gives warning in the shape of pain or defective vision; and then we fully realize what a calamity it is to have this sense impaired. Unfortunately in many cases the warning comes too late to enable us to restore fully the original and normal condition. A proper regard for the welfare of the eyes would seem to be only a matter of the most obvious commonsense; but like many other obvious precautions, it is overlooked until the protest is made by nature.

1, The *Illuminating Engineer*.

In modern civilization artificial light is something which every individual uses every day to a greater or less extent; and as the use of light involves the use or abuse of the eyes, the importance of an intelligent understanding of so utilizing light that the eyes will be decently used, and not abused, is at once apparent, Bad lighting is exceedingly common, so common in fact that, except in aggravated cases, it does not even bring forth a serious protest, unless occasionally when the bills appear to be excessive. It is one of the idiosyncracies of human nature that a gas or electric light bill, which is a dollar or two more than it ought to be, will bring on a veritable "brain storm," while a lamp or illuminating device which outrages the precious organs of vision every moment of its use, is accepted without the slightest protest, and in fact, often with real if unexpressed congratulations upon its "prettiness."

Now, it is a general truth that the right way to do a thing is the cheapest way also; and it will be a comfort for the consumer to learn that he can treat his eyes with decent respect and his pocketbook with equal respect at the same time. Bad lighting is in almost every case expensive lighting also, not from the merely theoretical point that anything bad is really expensive at any cost, but in the actual dollars-and-cents amount of its cost.

The old-fashioned open fireplace was a bad way of heating a room; it created drafts which were positively dangerous to health, and toasted your face while your back was freezing. As might be expected, the method was also uneconomical to the highest degree; the single virtue that it possessed was that it looked pretty. The average methods of lighting still in use may be fairly compared to this now obsolete method of heating. In many cases—probably the majority—a large amount of light is wasted by being scattered about where it is not at all needed and is often positively objectionable, much as the old fireplace used to send 90 per cent. of its heat up the chimney.

Scientists and manufacturers tell us that there have been wonderful improvements made in the production of light within the last 25 years; and so there have—from their point of view. Much more powerful lights have been produced, more convenient means are at hand of distributing and supplying the energy which produces the light, and the actual cost of these particular forms of light has been gradually reduced. But *producing light* is one thing and getting good *illumination* is quite another. So far as illumination is concerned, that is, the use of light for making objects visible, the most skilful illuminating engineer, utilizing the latest improvements, can produce no better results for the most common uses of illumination, such as reading, writing and the ordinary work of the household, than could be produced if gas and electricity were unknown quantities. So far as actual illumination is concerned, even the candle of our grandfathers is capable of producing results far better than are often produced at the present time with the most approved electric or gas lamps and the illumination from a good kerosene oil lamp has not yet been surpassed for the purposes mentioned by any illuminant known to science. Admitting the truth of all this, however, does not imply an impossibility to secure equally good illumination with modern illuminants, in addition to many and great advantages by way of convenience, cheapness and appearance. The fact is simply this: Good illumination can be produced with the old illuminants; equally good illumination can be produced with the new illuminants when properly used, but with careless or improper use a very inferior illumination may result.

The older forms of illuminant were far less liable to abuse than the newer forms. It is just this possibility of serious abuse of the many newer forms of illuminants, as well as the greater variety of effects, greater convenience and greater economies possible with the newer, that has called forth the specialist in the subject of lighting, and established illuminating engineering as a distinct branch of science. While the services of such specialists may be profitably employed in large installations, and in many cases in the smaller ones as well, there are many simple points which the average consumer can observe and engineer for himself. This is especially true of the ordinary dwelling house, and it is to this, therefore, that we will direct our attention.

The several different illuminants used for domestic lighting are candles, kerosene lamps, gas flames, mantle gas burners and electric lamps. The candle has not become obsolete by any manner of means; it still holds an important place in domestic lighting on account of its portability, and the decorative features possible with it, the latter being much enhanced by the sentiments and associations which cling to this "light of our fathers." On account of its portability the candle is often used as a light to carry about for temporary use into dark closets, infrequently used rooms, etc. It has one serious objection for this purpose which is overlooked to a greater extent than it should be, and

that is the danger from setting fire to draperies or clothing. There are exceedingly convenient little electric candles, operated by small batteries which can be easily purchased and replaced, that are in every way more convenient and absolutely free from this danger, and which should, therefore, entirely displace the candle for such use. For special decorative features, as for dining tables, the candle will long hold its place; in fact, so well recognized is this use that it is very largely imitated by both gas and electric devices; though, as in other cases of imitation, they never produce quite the effect of the "real thing."

Kerosene lamps are, generally speaking, well used; and, barring the care necessary to keep them in order, are very satisfactory lights for reading, writing and sewing. The lamp is commonly placed on a table and provided with a shade which hides the flame and gives the proper light on the work.

Gas flames are still frequently used, notwithstanding the mantle burner gives a very much larger amount of light for a given amount of gas. The ordinary gas tip is always ready to light, while the mantle burner may not be; and where a light is only occasionally required, the gas flame is the better form to use. As simple as it is, the form of the gas tip is a matter well worth attention. Some gas tips give a flickering, irregular flame, which will break up glassware nearly as fast as it is put on; and although this fact is not so apparent, it is wasteful of gas as well. The ordinary lava tip, having a plain slot through the center, is ordinarily of this character, and should be discarded on general principles. Aluminum tips have come into the market to a considerable extent; but while these give a large, steady flame, they are highly wasteful of gas and should therefore be avoided. The best forms are those which have two small round holes in the top and are fastened into the short piece of brass tube or "pillar" which screws on to the gas fixture. The Bray tip is one of this kind, which is made in England; but there are others on the same principle and equally good, produced in this country. Your plumber may not be familiar with this kind of burner tip; but if he is not, your gas company will gladly supply you at a trifling expense. In many cases a tip burning but 1 foot of gas per hour will answer every purpose, and the 3-foot tip will serve where more light is required.

Where light is required regularly, however, the mantle burner should always be used. These can be had in a great variety of forms, and in prices varying from 10 cents to $2. The 10-cent burner is capable of giving nearly as good results as the average burner that is much more expensive, *provided it is properly adjusted* to get the right flow of gas and air; but unless you are capable of making this adjustment yourself, it will be better to purchase the more expensive burners, which the dealer will either put up and adjust, or which have adjusting devices that are so simple as to require no more skill than turning an ordinary kerosene lamp up or down. For house use, the smaller burners should be selected. On tests which we recently had conducted with various sorts of chimneys, it was found that the short, straight chimney gave the greatest amount of light for a given amount of gas. These little chimneys can be had at any good supply store, made of an exceedingly thin and tough glass, which will stand almost any amount of heating and cooling without breaking or discoloring. If the small chimney is used, it should always be of this quality of glass. Mica chimneys soon discolor and become more or less opaque. A combined chimney and globe, that is, a chimney of an oval form with holes around near the bottom, is also much used; it is ordinarily made of opalescent glass, and, while not quite so efficient as the little straight chimney, it is handsomer and gives very good results, and is perhaps the best selection for ordinary use, as it requires no diffusing globe outside of it. Mantles also vary greatly in price and quality. While the 10-cent mantles will give very good results for a time, on the whole it is better to buy those that are somewhat more expensive. All mantles deteriorate by use, and, if not broken before, should be thrown away when they have run down in brightness.

Within the past year or two an inverted form of mantle burner has been put upon the market and very largely advertised. The principal advantage claimed is that more of the light is thrown down, where it it is more useful. This advantage is more fanciful than real, for it is a very simple matter by the use of a suitable reflector to throw the light of the ordinary upright burner either below, or in any other direction where it is wanted. The inverted burner does not work well on low gas pressures, and before purchasing them it would be well to find out whether the pressure commonly supplied is high enough to operate them successfully. The gas company will probably give you honest advice on this point if asked.

Mantle burners are often used on table lamps; for this purpose they should, of course, be provided with a shade which will shield the eyes from the direct light of the mantle. All mantle burners give out a large amount of heat, and this is somewhat objectionable in the case of a table lamp, as radiated heat is very trying to the eyes. It is often better to place a burner, provided with a reflector which will throw the light down, on a chandelier, taking care to sit so that the light will fall over the shoulder when reading.

If you think your gas bills are too high, remember that the ordinary lava tip, and the metal tip, are very wasteful of gas.

The ordinary tip burns 5 or 6 feet per hour, and in many cases a 1-foot tip will give all the light necessary.

A mantle burner will give 4 times as much light for a given amount of gas as the ordinary flame.

Decorative shades absorb from 25 per cent. to 75 per cent. of the light.

Electric lamps, being capable of such a great variety of uses, afford a proportionately greater opportunity for bad effects. We can take up here only some of the more frequent troubles and faults and show how they may be avoided. Let us first consider the reading lamp. So common are bad effects obtained with electric lamps for this purpose that there is quite a widespread belief that the electric lamp in itself is not well suited for reading purposes. This is an absolute mistake. The light itself from an electric lamp is as capable of giving good reading illumination as the light from the best kerosene lamp; although it is not uncommon, even where electricity is used for general lighting, to find a kerosene lamp used for reading purposes. An electric lamp gives all of its light from the fine carbon thread or "filament" within the bulb. This filament is, therefore, intensely brilliant—vastly more so than a gas or lamp flame; and such a lamp should never, under any circumstances, be so placed that the filament can be seen when reading. Even though the eye does not look directly at it, the effect may be equally harmful, since the eyelid is semi-transparent and not a safe protection against this very high intensity. In the second place, the light direct from a bare electric lanp is not even; if you place a sheet of paper near such a lamp, you will see that the paper is not evenly illuminated, but covered with various streaks of light and shade. Such illumination on a paper or book is bad for the eyes, as the eye, in running along over the sheet, sees first light and then dark, which produces the same effect as light that flickers. The electric reading or table lamp as commonly offered for sale is primarily a piece of bric-a-brac, gotten up entirely from the decorative point of view, and without any regard for the practical use to which it is to be put. It is very frequently provided with some sort of a fancy stained glass shade, or has a silk umbrella over it, all intended to catch the eye of the purchaser when making his selection *by daylight*. The shape of the shade may be such as to reduce the light to such a small circle underneath the lamp as to necessitate putting a book or paper almost under it in order to see; or it may be so extended, and the lamp so placed that the filament shines directly into the eyes. In practically no case is any provision made for diffusing or softening the light, so as to prevent the streaks of light and shade which we have just mentioned; and lastly, no reflector is used excepting the slight reflection which may take place from the glass or silk, and as a result two or three times as many lamps have to be used as is necessary. Unfortunately it is quite troublesome to remedy these very serious defects in the class of table lamps described.

A single electric lamp of the ordinary size, 16 candle power, will furnish sufficient illumination for 3 or 4 persons, if it is properly used. An inexpensive, but very pretty and efficient table reading lamp may be gotten up by selecting a plain standard that is rather high, say 18 inches; have a holder put on this which will support a straight-side prismatic glass reflector about 10 inches in diameter; see that the electric lamp projects well up into this reflector; over this glass reflector place a shade of silk or tissue paper of a green tint; extend this so that when the lamp is in the ordinary position the filament cannot be seen. The prismatic reflector lets a little light through, which will give a pretty glow to the paper or silk shade, and at the same sime throws the light down where it is wanted for reading, and also practically does away with the light and dark streaks. A plain porcelain reflector, white on the inside and green on the outside, will give about equally good illumination, but is not so decorative.

Never in any case sit with the light directly in front of you, as you are sure to get a reflection which produces a blur on the paper.

It is very common to find in apartments and houses of the present day a chandelier having an "art glass" shade in the center intended for lighting either a dining room or library table. Within this shade there is usually a cluster of from 2 to 6 electric lamps; and in order to secure a satisfactory light on the table, it is usually necessary to use at least 2, and often 4 of the lamps. Again a single 16-candle power

lamp will furnish all the light necessary if properly used. Have the cluster taken out and a single lamp put in the center and so placed that a prismatic glass reflector can be used with it. As with the table lamp, the light which passes through the reflector will illuminate the art glass shaed enough to produce the decorative effect, while throwing down the most of the light on the table where it is wanted.

In the general lighting of the room there is usually a waste of one-half the light, more or less, by the use of ornamental globes and shades. We would not have it understood that lighting is not to be decorative, and that all forms of ornamental shades are to be discarded; on the contrary the electric lamp, except where infrequently used, should invariably be provided with some sort of a diffusing shade. Of the various forms of ornamental shades, those of etched or "frosted" glass waste the least light, and those of opal and art glass the most; the latter may use up as much as 80 per cent. of the light given, and their use is justified only where they are to serve primarily as ornaments. Prismatic glass globes are primarily intended to diffuse the light while throwing it down more or less, like a reflector. They therefore actually increase the light underneath, but do not soften it quite as much as frosted or opal globes. They should be chosen where economy is of greater importance than decorative effect.

Frosted lamps soften the light sufficiently for all ordinary purposes, but only last about half as long as the lamp with a clear bulb.

If you find your electric lighting bills too high, look after the following points:

The ordinary size lamp is of 16 candle power and this is the size that the lighting company will ordinarily furnish you unless you specifically ask for something else; in many cases a lamp of 8 candle power, or even 4 candle power, will answer the purpose equally well.

All electric lamps fall of in the amount of light with use, a 16-candle power lamp sometimes falling to 8 or 10-candle power, while taking nearly the same amount of current. Do not wait for a lamp to burn out before discarding it; as soon as the bulb is so blackened that the filament looks reddish, discard the lamp. Using lamps long after they should be thrown away is one of the most common methods of wasting current.

The ordinary electric lamp gives twice as strong light sidewise as it does through the end. Unless such a lamp has a reflector it throws twice as much light on the side walls as below.

Lamps can be had which give the strongest light through the end; and these should be used where it is not desirable to use a reflector.

If you find the light hard on the eyes, do not at once assume that you need more light, but see that you get the light softened and free from all streakiness, and also that it comes from such a direction as to not shine directly into your eyes or on to a paper in such a way as to blur it.

Remember that fancy tinted and opal globes use up 75 per cent. of the light.

Schemes for Increasing Business.

By Mr. J. G. Learned, Chicago.

Mr. John G. Learned, contract agent for the North Shore Electric Company, operating in the suburban towns around Chicago, presented a paper in competition for the Co-operative Electric Development Association's prizes last spring, which contains a number of interesting statements as to schemes his company has worked in securing new customers. The following are extracts from his paper:

Experience taught that in order to get the best results agents must be paid a salary and a very liberal commission on business secured. By doing this the results were far more satisfactory than when a straight salary was paid. It is absolutely necessary at times that the central stations should maintain a wiring department and should also encourage private local parties in the wiring busines. The more competition in the wiring business the quicker your load will grow. If necessary, throw a few wiring jobs to the local man. Induce the man selling appliances to visit your territory. This also pays. If feasible, get all and any firms handling reliable electric appliances to solicit in your community.

We all know that the residence owner hesitates to have his home torn up, as he thinks it will be, and sometimes is, in order to install electric lighting, wiring and fixtures. Again, the expense prevents a man taking this step to comfort and convenience. Give the resident prospect a cost estimate for wiring his place. We find that by offering to put in the wiring and fixtures at cost on monthly installments we have secured a very large number of old houses which, if it were not for this proposition, would still be using antiquated methods of illumination.

It is the old residences that need the most attention. New ones will come in as a matter of course. It is a very easy matter to induce a man building a new house to have it wired. Wiring for a porch lamp at cost has been the means of securing a very large number of customers. Sixty customers were secured out of 275 people approached by a circular letter, which is a very large percentage. The cost of operating a porch lamp is nominal and rarely runs over 75 cents or $1 per month. It pays to put in a service for one lamp, because it is only a short time before the entire house or part of it is wired. After the porch lamp, the next proposition for an old residence is to wire for 6 outlets at a price of one-half of the actual cost, the outlets mentioned to be placed as instructed by the consumer with restrictions according to the conditions existing in the particular locality. Six outlets will give the customer a chance to try the light, and it will invariably result in ordering additional lamps. This proposition was offered to about 600 old residents, out of which 53 responded and 23 were secured to the service. The average man is always ready to accept something which is apparently free. Therefore, for a perior of 3 months make a standing offer to allow $25 worth of energy free to any resident who wires his home for a certain number of lamps during that period, said free energy to be used within a specified time. The results from this offer were very gratifying; in fact, flattering; as about 40 old houses which before making the offer were almost impossible to reach, readily came on the service.

The following very attractive proposition was offered to a selected list of about 200 residents who owned their homes:

"We will bring our lines to your premises, install our service and at your direction wire for not to exceed 6 single electric outlets, entirely free of cost.

"We would suggest a light for the porch, controlled by a switch in the vestibule; one in the library for a reading lamp; one in the dark clothes closet which will eliminate all possible danger of fire, and one in the furnace room, controlled by a switch at the head of the stairs.

"All we wish is that you agree to use electricity for burning the lamps for 2 years, and that your monthly bill be at least $1.

"It is our intention to make but 100 of these installations, and the first 100 applications we receive will obtain this wiring free of cost. This involves an expenditure of a very considerable amount of money on our part, and if at any time you conclude to equip your premises throughout for the use of electric light, it will make a very material saving in the expense.

"The inclosed postal card with your name and address, mailed to us, will bring our representative, who will be pleased to give you full information on the subject."

Seventy responded to this letter, and, as a result, the central station was successful in securing 47 old residences, all of which are considered very good customers. Their bills average about $3.50 per month, this average taken for a period of 8 months. The average cost of wiring each of the above houses mentioned was about $20.

The foregoing are a few of the schemes which have been used with success in obtaining old houses on the system. A new proposition will always bring in a few of the old residences.

Most towns have a few tenement and flat buildings, and it is sometimes a task to obtain the lighting of these buildings. It is a good policy to have them wired at any cost, having the halls wired separately from the flats. This being done in the first place, the rest is easy. As a rule, tenants in flat buildings are very good customers, easy to secure and easier to hold. In order to secure and hold the hall lighting, allow the owner a special commission in the form of a discount on his hall lighting, this discount depending upon the number of customers in the building which use the service. As the result of this proposition, the owner or agent of the building are instrumental in having a backward tenant use light. This proposition also applies to office buildings. Right here it is important for the district solicitor to win the heart of the janitor of the building, as he is of great value to the central station in securing flat customers, as he is on the ground with the prospective customer at all times and a word from him goes a long way in convincing the prospect that he should use electric light.

The problem of securing store business we are ready and willing to admit is a very difficult one. Many schemes and methods have been tried. The writer suggests, however, to start the wayward store customer using electric light by first getting him interested in lighting his windows. To him window lighting is a matter of experiment. In order to show him that it is not an experiment with you, but an absolute necessity and that you have confidence in the fact that he will continue to use electric service, wire his windows free of charge. You

may hesitate to do this, but it is good business. It is not only an advertisement for the storekeeper, it is also the best advertisement the central station can obtain. Induce him to use the light in his windows when he has closed the store. In order to sell goods you must show them, and show them under tne most favorable conditions. This may be done by using electric light. Teach him how to light windows, and why, because it is his best advertisement. Impress upon him the necessity of showing his goods and show them under the most favorable conditions. In a district where you find that it will pay to maintain patrol service, install arc lamps on a flat rate basis.

One branch of the electric lighting business too often neglected is signs, which means big revenue and is a good advertisement. Hang a sign in front of your office; also one or two in another portion of your town to advertise your business. If you show the public that you believe in signs they will follow suit and you will find that the sign business will grow. Adopt a standard sign. There are several companies that now make a specialty of furnishing contral station companies signs at a reasonable price, which may be used time and time again. Signs furnished free to the customer have been means of securing a vast amount of business. By free the writer means that the signs are furnished, hung and connected without expense to the consumer, under a special contract whereby he agrees to use a certain amount of energy each month. If patrol service is convenient, furnish the sign on patrol basis; if not, on meter basis.

It is often surprising to learn of the many places where motors may be installed. Sell motors at cost or as near cost as possible. Rent them. Place a motor in on trial. In fact, do anything and everything to obtain the consent of the consumer to take power service. The writer does not know of one case in which the service once installed was removed.

Rontgen, Cathode and Positive Rays.

The concluding lecture of the course delivered by Professor J. J. Thomson, F.R.S. (Cambridge, England), before the Royal Institution, England, was rendered the last Saturday in March. In the preceding lecture he noted that he had shown that if the cathode of a vacuum tube was perforated, streams of ruddy phosphorescence passed through the holes into the dark space behind. These streamers, he now pointed out, were merely, as indicated in Fig. 1, a continuation through the perforated cathode of a similar phosphorescence in front of the latter, named the first cathode layer by Goldstein, the discoverer of the phenomenon. The spectroscope, he proceeded, showed the ruddy glow on the two sides of the cathode to be identical in character. These positive rays had very different properties from the cathode rays. They were not easily deflected by a magnet, whilst the cathode rays were. Moreover, when a substance was caused to phosphoresce by the impact of the cathode rays, the light had in all cases a continuous spectrum; bombardment by the positive rays, on the other hand, gave a line spectrum, the lines present depending on the nature of the substance struck. Lithium chloride, he showed, phosphoresced a bright red when struck by the positive rays, and the spectrum under these conditions showed the lithium lines. Acted on by the cathode rays it phosphoresced a steely blue, and the spectrum proved continuous. These positive rays, he proceeded, might afford very considerable help in solving some problems connected with the emission of light. One very suggestive fact about them was that they produced the spectral lines only when they struck salts of the metals. Thus pure sodium or pure potassium, if bombarded, gave no lines in the spectrum, but the salts of the same metals similarly treated gave the lines very strongly. This, he proceeded, was well shown in the case of the liquid alloy of potassium and sodium. This alloy always contained specks of oxide, and if the rays were directed into a pool of it, these specks shone out as bright yellow stars on a dark background, and yielded the sodium lines in the spectroscope. This fact was, he considered, very suggestive as to the origin of the lines on the spectrum.

This property of the rays—of producing luminosity in the places they struck—made it possible, he continued, to follow the course of the rays in a discharge tube, and to detect their deflection under the action of electrostatic and magnetic fields. Wien was the first to show that these rays consisted of positively electrified particles moving at considerable velocities, which he determined on the same plan as that already described in a previous lecture, by which the velocity of the cathode rays was measured. The deflection of the rays under electric and magnetic forces could, Professor Thomson continued, be shown by the apparatus represented in Fig. 2. Here the cathode A consisted of a fine tube, the nozzle of a hypodermic syringe being conveniently used for this purpose. The positive rays passing through this cathode struck the end of the glass tube at E, which was coated with willemite, and made a spot of light. On their way they passed between two plates D, which could be oppositely electrified, and a magnetic field could also be established across the line of their path. The plate B was a shield of soft iron to prevent the influence of the magnetic field extending to the left of it. With not very low pressures in the interior of the apparatus, the spot, Professor Thomson said, was not so much deflected by the electrical or magnetic fields, as drawn out in the fashion represented in Fig. 3, which represented the phenomena observed when air was the gas traversed by the rays. Here the round spot represented the spot of light produced when there was no deflection of the rays. The vertically hatched extension showed how this spot was drawn out when the electrical field alone was in action, and the short branch on the left showed in the same way the drawing out of the spot when the magnetic fieid only was present. The cross-hatched patch, on the other hand, showed the band produced when both fields were simultaneously in action. A faint luminosity was, moreover, observed below the original spot; and the direction in which this was deflected indicated that it was due to negatively electrified particles.

Calculating the ratio $\frac{e}{m}$ in the manner explained in a previous lecture, from the deflection observed under the action of both fields, it appeared that this ratio for the lift-hand boundary of the cross-hatched strip turned out to be 10^4, or the same as hydrogen. Under all conditions of the experiment this ratio was obtained for the boundary of this strip, but all ratios between this maximum value and zero were simultaneously present. Wien, who first observed this, ascribed it to the formation of complex systems round the moving positively-charged particles, acting as nuclei, which thus got loaded up on their path. It appeared, however, that in order to reconcile this theory with experiment the amount of loading required would be in the ratio of 10,000 molecules to one positive particle. Hence it was difficult to accept this view, and Professor Thomson suggested that the discovery of the negative tail, indicated in Fig. 3, led to the true explanation of what occurred when positive particles made their way through a gas. They might, he considered, easily attach to themselves one of the light negative particles, and would not then be acted on by the field, and hence the final deflection would be reduced. Since the mass of the negative particles was small, their attachment to the positive particle would not appreciably alter the velocity with which the latter moved. The deflection shown by the spot of phosphorescence was thus an indication of how far the positive particle had moved before it was neutralized. The negative tail was produced by the corpuscles shot out of the residual air by the impact of the positive particles.

The ratio $\frac{e}{m}$ came out, Professor Thomson proceeded, equal to that of the hydrogen atom in electrolysis. There was no indication in the bands of the presence of nitrogen or oxygen, and yet hydrogen had been very carefully removed. When a similar experiment was tried with hydrogen in the discharge-tube the spot was spread out into bands, as indicated in Fig. 4. Here the ratio $\frac{e}{m}$ for the cross hatched band was 10^4, and for the other band about half this, corresponding to either the hydrogen molecule or to the a particle from radioactive bodies. These were the only ratios to be found. With helium somewhat similar deflection bands were shown, one of which corresponded to a ratio $\frac{e}{m} = \frac{1}{4} \times 10^4$, equivalent, therefore, to the helium molecule. The results indicated in Figs. 3 and 4 were all obtained with not very low pressures in the discharge-tube. When, however, the discharge took place through exceedingly high vacua, the spot was deflected, as indicated in Fig 5, which represented the case of helium. Here the ratio $\frac{e}{m}$ for the upper of the left-hand lobes was 10^4, and for the one below it $\frac{1}{4}$ this, and there was no indication of the presence of particles with a ratio of $\frac{1}{4} \times 10^4$.

At very low pressures the 3 ratios of 10^4 and half this quantity alone were observed, no matter what the residual gas. It might, of course, be suggested that in each case one and the same gas was really concerned, being occluded from the walls and electrodes, hence the identity of the results obtained; but Professor Thomson said that he did not think that this thesis could be maintained. In the first place the gas occluded from the electrodes was not entirely hydrogen, strong bands of nitrogen being visible in it when examined spectroscopically. Nor could the phenomenon be accounted for by the introduction into the

tube of hydrogen and helium. Indeed, no matter what the precautions taken, these two values of $\frac{e}{m}$ only were obtained, whatever the nature of the gas, provided the electrical field used was very intense. It appeared, therefore, that under strong electric fields all gases gave off the same two kinds of electric carriers, one having a ratio $\frac{e}{m} = 10^4$, and the other half this. The same uniformity was not, however, obtained when weak fields were used. The velocity of the particles could also be measured from the deflections of the phosphorescent spot under the action of the fields, and this proved to be of the order of 600 miles per second. They were, therefore, moving very rapidly. Starke had ab served the discharge in the spectroscope and proved the existence of a Doppler effect, the spectral lines being displaced in the same way as those of the spectrum of a star moving radially to the observer. The speed of the particles calculated from this displacement agreed with that determined by the electro-magnetic measurements. The matter had been further examined last year, at the Cavendish Laboratory, by Professor Howe, who got very clearly marked Doppler effects in the case of hydrogen, but with helium and mercury vapor got no such effect at all. In hydrogen, on the other hand, the Doppler effect was so marked that even rough instruments served to measure it, whilst with He and Hg the most refined "interference" methods failed to show any displacement of the spectral lines, though they should have sufficed to detect velocities of but 60 meters per second. There was, therefore, a certain amount of mystery about the action of the positive rays, and were this solved we should, he thought, have got far into a knowledge of the mechanism by which bright lines were produced in the spectrum.

An interesting property of the positive rays, Professor Thomson con tinued, was that if they struck against a metal plate, such as *C*, Fig. 6, they caused the emission of cathode rays. In the vacuum tube they struck in this way the cathode, and thus enabled the cathode rays to start. This property of the positive rays was, he proceeded, essential to the maintenance of the discharge through such a tube.

Coming next to the α particles emitted from radioactive bodies, Rutherford had shown that the ratio $\frac{e}{m}$ was in this case $\frac{1}{2} \times 10^4$, or the same as one of the two values always observed in the case of the positive rays produced in a gas at a very low pressure. These α particles had, however, some interesting properties not possessed by the kanalstrahlen. If negative particles or Röntgen rays were passed through absorbing materials, the intensity began to diminish at once. Bragg and Kleeman had shown, however, that if the intensity of the α rays was measured by their powers of producing phosphorescence or ionziation, there was at first no diminution of this intensity. Thus, if a phosphorescing screen were held in the path of a narrow pencil of these rays, there was actually a slight increase in the brightness of the phosphorescence, as the distance of the screen from the radium was increased from 0 up to about 4 centimeters; but, then, on still further increasing the distance, the light disappeared suddenly and entirely. Hence the α particles were said to have a certain range which varied with the substance from which they originated. Early experimenters on the absorption of α rays had failed to note this property owing to working with the rays emitted from a large extent of surface in place of with narrow pencils. Whilst, as stated, there was at first no diminution of the intensity of the rays as measured by their powers of producing ionizations, this was not true of their other properties. Their velocity in particular steadily diminished from the outset. Rutherford had shown that the α particles from radium lost their power of producing phosphorescence when their velocity fell to 60 per cent. of its original value, which was one-twentieth that of light. When these rays ceased to ionize, they still had, therefore, a velocity much in excess of the most rapid kanal-strahlen it was possible to obtain, and the latter, nevertheless, did cause bright phosphorescence.

There were two suppositions on which it was possible to reconcile the different behavior of the positive particles in the two cases. In the first place, it was possible that the α particles when traveling through the air attracted to themselves negative particles, and when their velocity fell below a certain limit, were unable to get away from these negative particles, and were thus neutralized. In the second place, phosphorescence and ionization might be cumulative effects, and if impacts succeeded each other sufficiently rapidly, the effect of one collision might last till a second occurred, so that if repeated in rapid succession, the impacts might produce phosphorescence, though the individual effect of each was small. With the α particles, which were

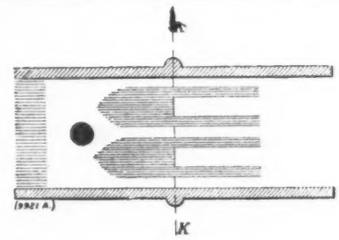


Fig 2.

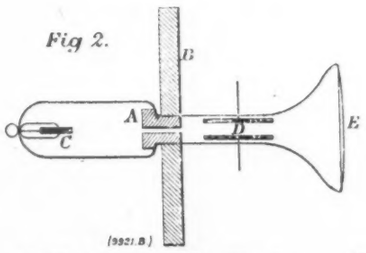


Fig.3. Fig.4. Fig.5.

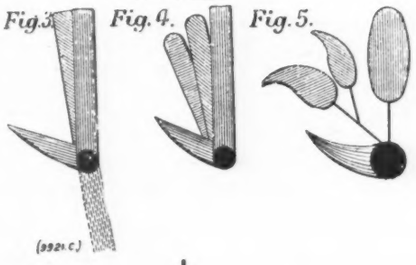
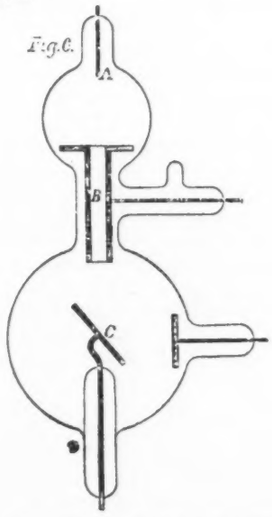


Fig.6.



less in number than the particles in the discharge tube, each had to act on its own account, and hence might require a lot of energy to effect ionization.

Positive rays of a different kind had, he proceeded, been detected by Professor Beattie, who found that certain salts, when heated, gave a discharge of positive electricity. The matter had been further investigated at the Cavendish Laboratory, and it was found that the amount depended on the nature of the salt, the best results being obtained with aluminum phosphate, from which a discharge could be obtained sufficient to deflect a not very sensitive galvanometer. Where an electric discharge was produced by heating, its character depended, it was found, on the nature of the salts. With oxides the discharge was always negative, and with phosphates always positive. On the other hand, oxides, if rubbed, became positively charged, and phosphates negative, so that rubbing and heat might be considered to have the same effect on removing the outer coating of the hypothetical "double layer" covering the salts.

In conclusion, Professor Thomson remarked that a further investigation of the properties of positive rays in general appeared now the most hopeful field for future research.

CONSTRUCTION work on the gas plant for Missoula, Mont., is underway.

The Plan and Scope of the Illuminating Provision, Building of the Engineering Societies.

For the following particulars of the plan and scope of the means taken for the illumination of the magnificent building of the Engineering Societies, West 39th street, between Fifth and Sixth avenues, New York, we are indebted to the courtesy of Prof. F. R. Hutton:

Complete specifications were prepared and sketches made by the consulting engineers, acting in co-operation with the architect, for the illumination of every room, and for every fixture in the building. It was realized by the engineers that the illumination was necessarily only one feature of the building and must be subordinate to, and in harmony with, the architectural features.

The central space in the entrance hall or foyer is lighted by means of individual lamps, placed in recesses, and concealed by panes of ground glass in the ceiling, at the sides of the rectangle formed by the columns around the large central area. In addition to this, larger crystal balls are provided in the outer corridor beyond the central space and in the elevator hall, entrances, etc. The effect of the individual lights in the recess, screened by glass, is to afford ample illumination without any glare.

Crystal glass balls, holding "metalized filament" lamps of various sizes, from 50 to 250 watts, are used on the principal floors, from the first to fourth, inclusive. In some cases pagoda reflectors are used inside the balls to increase the effective illumination and to reduce the current consumption. In other instances, however, in order to subdivide the number of lights in the hall fixtures, several lamps have been placed inside the crystal balls. In all such instances the metal plate at the top of the fixture supporting the sockets has been silvered to act as a reflector and to increase the efficiency as far as possible.

In the halls above the fourth floor, glass globes have been provided to screen the lamps. These globes, made according to the specifications of the electrical engineers, are unusual in the fact that the intrinsic brilliancy of the lamp is reduced without an excessive loss in the efficiency, and at the same time a warm, pleasing opal glow is produced.

The lighting of the auditorium is the most effective and probably the most interesting feature of illumination in the building. The result was obtained by the complete co-operation of the electrical engineers with the architects. At the engineers' suggestion the architects provided a space of about 15 inches between the ceiling of the auditorium and the beams of the floor above. At the suggestion of the engineers, also, a glass septum was substituted in place of the proposed plaster panels in the ceiling. The details were then carefully worked out as to obtaining access to the lamps for renewal, and tests were made by the engineers to find a glass that would reduce the intrinsic brilliancy or glare, and at the same time would not have an amount of absorption prohibitive on the score of economy. The result obtained has been very satisfactory, and it is possible to sit through an entire lecture without being disturbed or distracted by the lighting. The general effect is both soft and pleasing, and resembles or suggests sunlight passing through glass, as at Napoleon's Tomb in the Invalides, in Paris. As a matter of fact, the solid arches of the floor above are within 2 or 3 feet of the glass through which the light passes. Additional lighting screened by the same kind of glass is provided at the rear and at the sides under the balcony. Dimmers are provided for reducing the amount of illumination in the auditorium to any desired point, and also for the purpose of gradually increasing the lights to the maximum, after the room has been darkened for a stereopticon, thereby avoiding the unpleasant sensation produced on the retina of the eye, by flooding the room with light immediately following comparative darkness.

The lighting of the assembly and lecture rooms was also designed to prevent the lights from being distracting or unduly noticeable. For this reason, the cove method was adopted, with additional outlets in the ceiling for supplemental fixture lighting. The difficulties of the building construction, did not admit, in all cases, of obtaining continuous coves, nor coves of the exact form and dimensions desired. While the cost of lighting by this method is in excess of that using exposed lamps, the fact that the rooms are not in continuous use, but occasionally, for lecture purposes, offsets this objection.

The general illumination of the library is obtained by means of lamps placed above the glass ceiling skylight on a plan similar to that used in the auditorium, the glass in the ceiling skylights being of the same kind as that used in the auditorium ceiling. In addition, ceiling outlets are provided for general illumination, so that the indirect lighting above the glass need be used only at certain times. The light for reading is obtained by means of standard fixtures placed upon the tables. The general effect is charming and agreeable.

[Concluded from page 583.]

Reducing Dust and Hardening Roads by Surface Applications.

Impregnating Road Surfaces with Special Coal Tar Products.—The use of coal tar and its products as ingredients of pavements and roads has been undertaken in many ways for about 50 years, but with no success until quite recently. It is used in the general group of pavements called tar macadams, composed of hot, crushed stone and specially prepared tar or bituminous cement mixed while hot and compressed in place. Of this group that which is known as bitulithic pavement seems the most successful for streets, and in lighter form (I believe it is known as bitrock) for suburban roads and the interior of villages and small towns.

We must know the difference between a tar macadam and tarring a macadam road. A tar macadam, as stated in general, is a mixture of heated crushed stone and specially prepared adhesive tar cement mixed by machinery, spread and compressed. The best type of tar macadam at present being the one devised by the late Mr. F. J. Warren, he made it clear that not only his pavement, but that all macadam pavements should have voids between the larger crushed stone, so filled with smaller and smaller broken stones that they mutually sustain themselves in position as a solid mass, and do not depend upon the adhesion of the tar product or any binding substance to hold them in place. The cement acts simply as a final filler of small pores and a waterproofing material within and upon the macadam.

The tarring of a macadam road means sprinkling, painting or covering its surface with soft tar specially prepared for that purpose, which will penetrate the macadam, make it waterproof and retard the formation of mud and dust. A prepared tar which is sufficiently fluid to lay dust and penetrate the surface of the macadam cannot be a binding material to hold together any portion of that macadam, except the finest particles of dust.

Specially prepared coal tar by surface application on macadam to eliminate dust and make the macadam waterproof and more durable first succeeded in Melbourne, Australia, in 1886, where the experience gained has been followed by constant use ever since. Tar freed from water and very light oil and otherwise improved is used. The macadam is first well bonded and consolidated, then tarred and fine stone screenings are spread. Coal tar products are suited only to hard macadam and similar roads because it is not practical and economical to use these products on soft earth, clay and sand roads. The cost would be too great; sufficient tar is not available. It would not harden. It is better and cheaper where obtainable to use suitable asphaltic oils on soft and absorbent roads as is done in California.

Near Fontainbleu, France, the road to Paris was tarred during 1903-4-5. The cost of repairs and renewals is less than by the old methods without tarring. The repairs to the macadam itself are reduced to about ¼ of what they were. The tarred surface produces little dust.

The Vendee District, France, based on records begun in 1896, shows as follows: One highway, 20 feet wide, was tarred in the following manner: The macadam was put in good condition, well rolled and used by traffic for a month; then thoroughly cleaned by stiff brooms followed by fine brooms. Hot tar was spread over the macadam. It percolated into the macadam, the work being done in warm weather with the road very dry. It penetrated 1 inch in 4 hours and 1¾ inches in 24 hours. The first tarring required about 1.9 pounds per square yard; 12 hours after tarring each section clean sand was spread. The surface was then rolled and opened to traffic.

One year later the operation was repeated, using less tar because the road would absorb less, then every second year thereafter. The road was practically free from dust, its wear was reduced to about one-half and the total cost of the road in 10 years was 40.4 per cent. less than under the old system of maintaining the road in constant good condition with macadam only. This was due principally to the fact that the tar saved $1,430, which would have been paid out during the 10 years for extra crushed stone and resurfacing, if the surface had not been tarred at intervals as stated. Tarring made it necessary to resurface with stone only once not twice as formerly.

A second road in the same district properly tarred costs 23 per cent. less on a basis of 14 consecutive years than if it had been maintained with macadam only.

A section of macadam road nearParis, as per report of the Government Engineer, M. Signult, shows that the tarred section needed only one cleaning in the winter of 1902-3 when 2¾ cubic yards of mud were removed from 1,131 square yards of surface of tarred section; whereas 32 cubic yards of mud were removed by 9 necessary cleanings from

the same amount of surface of untarred macadam on the same road under the same conditions of traffic.

The department of the Seine-et-Marne, France, which I have twice visited, shows that the expense of using special hot tar and using every precaution and all the skill possible, is warranted, and that the tar should not be applied to old, irregular macadam without first putting it in good order and having it thoroughly rolled and under traffic and weather for at least a month; also, that newly constructed macadam roads should be thoroughly compacted by rolling and open to traffic and weather for a month or more before being tarred. Reliance is not here placed upon the tar used to bond the macadam together, but simply to agglomerate the fine particles in the small pores of the macadam and make its surface waterproof.

Near Liverpool, England, tar painting as it is called, is used where the traffic is light. The macadam is first cleaned, then painted, covered with grit, and allowed to stand 2 or 3 days to soak. It is then consolidated with steam roller and traffic admitted. This suppresses the dust and gives longer life to the roadway with acceptable hygienic and economic results.

Holyhead Road, England, was dried, cleaned carefully with horse brushes and then with house brooms, hot tar was spread with special brushes, and the road covered with sand and traffic let on. The cost, on low English basis of labor, tar, sand and heating, was a little more than 2 cents per square yard per treatment. The treatment must be repeated twice the first, and once per year thereafter. The results are promising but not yet conclusive.

The tests of tarring made in connection with the United State Government, at Jackson, Tenn., in 1905, give interesting data for that locality. In addition to the quantity of special tar used (contributed free) and the cost of labor, I have estimated the cost of the special tar on the basis of the cost of "Tarvia," the material used. The price of Tarvia there I learn would be 6½ cents per gallon, F. O. B. works, plus freight. It is a specially prepared tar free from water, light volatile oils and of a uniform standard. It is not patented and can probably be made by experts. All costs considered, I estimate that the cost of .45 gallon per square yard, and of labor, heating and sand, was an average, at Jackson, of $0.04012. Freight on tar and superintendence added, make a total cost of a little above 6 cents per square yard for the first tarring. It penetrated about 1 inch into the macadam, and at the end of 7 months was in good condition. To remain constantly good it should have been all retarred in 1906. Parts, however, were retarred in October, 1906, and when examined, in January, 1907, were excellent. The road produces practically no dust, is waterproof and smooth.

Near Troy, N. Y., the State Engineer, in 1906, tarred a section of road. He cleaned the road, spread hot tar, covered it with screenings, consolidated it with traffic and repeated the operation twice. He used special tar from which the water had been boiled off and the result thus far is promising.

General Rules for Tarring Macadam.—I will indicate a few of the necessary principles to observe in tarring macadam. Before tarring, the macadam must be brought to grade and then filled with fine stone screenings, rolled and subjected to traffic about a month, or until consolidated and firm. The mechanical bond of the macadam should be as perfect as possible and not rely upon the prepared tar to do the binding as already described. Crude tars must not be used, as they contain water, ammonia and sometimes other objectionable substances according to their origin from different coke ovens and from many kinds of coal. If crude tars are purchased, they must be prepared by the buyer. It is probably best to get one or more of the prepared tar products of which the one mentioned is a type, or some tar product which fulfills the physical and chemical properties needed. These properties can be determined by an expert engineer familiar with them.

The work should be done only in warm and dry weather. The macadam should be first swept clean and sometimes washed, but should be allowed to become perfectly dry to a depth of at least 1 inch before applying the tar produce. The tar should be spread uniformly under competent supervision. It should be allowed to stand and percolate for at least several hours after being spread and then be covered, preferably with sand or with uniform, fine-grained stone screenings, containing no earthy matter or dirt. The tar should be applied as hot as possible at about 200° F. After the sand or screenings have been spread, it is best to wait several hours before rolling with a steam roller. During the rolling additional sand or screenings must be added if any tar squeezes up through them. It is a good plan to keep traffic off the finished rolled road for a short time after rolling. This is because the work is done in warm weather, and it is wise to let the tar continue to penetrate and become cool before opened to traffic. Tarred macadam roads are being used in many parts of the United States and Europe, especially where firm macadam and gravel roads exist.

The mixing of crude tar and hard pitch is not a good method, nor does it make that which is necessary for properly tarring macadam roads. A study of sections of roads which have been tarred convinces me that the tar at the surface of the road is oxidized by the air and other elements, leaving the ingredients of the tar, such as anthracine, paraffine and naphthaline in the road surface, and the softer oils below remain to give life to the lower strata. Because this oxidation takes place the road is hardened and made more durable. In time, as stated, the tarring must be repeated to supply new life by adding small amounts at proper long intervals. It pays in every sense to keep tar treated macadam clean, because accumulations of leaves and dirt, brought upon it, disintegrate the road, although not so much as ordinary macadam not tarred.

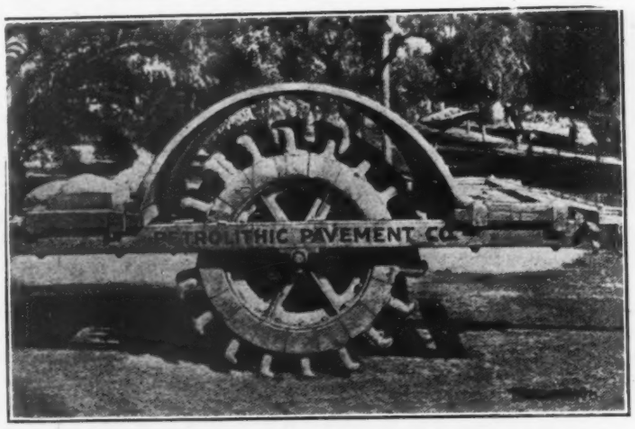
Each locality is a separate problem as to what available materials to use for constructing roads and what methods to adopt for reducing dust. My experience testing pavement and road materials in my laboratory and constructing pavements and road surfaces for many years in many places, convinces me that not cheap first cost, but economic maintenance, is true economy. This applies also to suppressing dust. Water alone or mixed with salts or with alkali and oil has a very limited application. Certain adhesive asphaltic oils for soft road materials and specially prepared coal tar products for hard macadam and similar roads, seem to be the present solutions of dust problems for thousands of miles of highways.

Asphaltic Dripped, Roller-Compressed Road Making in Santa Monica, Cal.

Engineering News notes that in the system of constructing oiled dirt roads in Santa Monica, Cal., and which has been adopted elsewhere in that vicinity, the heavy asphaltic oils used with so much success on the roads of Southern California is incorporated with the dirt found in site in the roadway, by means of plowing, harrowing and finally compressing with what is called a tamping roller.

Our attention was first called to this system of road construction by the specification therefor printed in the biennial report of Mr. N. Ellery, Highway Commissioner of the State of California (Sacramento, December, 1906). The specifications not being clear as regards the roller, owing to the absence of a description thereof, application was made to Mr. Thomas H. James, City Engineer of Santa Monica, for information regarding the roller and roads constructed with it.

Mr. James states that "the oiled paving process is known as the Santa Monica system," since it originated and was perfected by experiments in that city. The roller used in the work is known as the Fitzgerald tamping roller, and "has proven to be a great success for mixing and bonding the soil and oil until it becomes almost like an asphaltum pavement." At the inception of the "oiled paving process" in Santa Monica, the city leased the tamping roller to the contractors at the rate of $10 per block, or about 1¼ cents per lineal foot. At the present time many of the contractors own tamping rollers. During the past few years about 20 miles of "oil paved" streets have been constructed in Santa Monica. Even after severe rain storms these roadways and boulevards are in good condition, including those on 1 to 3 per cent. grades. Some of the roadways have been subjected to



Fitzgerald Tamping Roller for Constructing Asphaltic Oil Dirt Roads.

heavy team and truck loads without injury, many of the heavy wagons having narrow tires.

Mr. James states that although he has had no practical experience with the effect of frost upon these roads, yet he thinks frost would not penetrate them if the oil was worked down to a depth of 8 or 10 inches below the surface.

Regarding the cost of the roads treated by this system, Mr. James says:

The average cost per square foot of the oil paved roadways is from 1¼ to 2¼ cents, providing that in preparing the roadway surfaces the cuts or fills do not exceed 1 foot. Hence our oiled-paved dustless residence streets cost about $\frac{1}{10}$ the price of a first-class asphaltum pavement, or about ¼ the cost of concrete and paving brick.

The specifications, as slightly amended in February, 1907 (after the date of the report already mentioned), are as follows:

(1) Contractors shall use the tamping roller approved by the Superintendent of Streets and Board of Trustees of the city of Santa Monica for all work under these specifications.

(2) The streets shall be plowed to a depth of 6 inches and graded evenly with a crown to conform to the established height at center of street, and properly pulverized with said tamping roller, said tamping roller shall be weighted from 2 to 3 tons, and to form a solid base up to 4 inches from top.

(3) Where there is no cement or paved gutter, then the gutter 3 feet wide out from curb shall be done in the following manner: Remove the earth 6 inches deep below finished grade by the use of a grading machine, leaving earth so removed in the street, then loosen bottom, lightly apply water, sufficiently, then apply 1½ gallons of oil to each square yard of suface, evenly; refill 3 inches of loose earth, and water sufficient; tamp this evenly and solid, by using a wagon or truck with 4-inch width of tires weighted sufficiently to make a solid base; then back fill to grade. Gutters at street intersections as indicated by plans shall be of double width and constructed as hereinbefore mentioned.

(4) When the street is properly graded, pulverized and tamped solid to within 4 inches from the top, then apply water sufficient to thoroughly and evenly dampen to a proper consistency, 4 inches deep, loosen with a cultivator lightly set so as not to disturb sub-base, then the oil shall be applied as follows: The street shall be coated evenly with oil at the rate of three-fourths of the amount to be used, then plow the oil under 4 inches deep with a gang plow, commencing at center of street; then harrow diagonally two ways and then tamp with tamping roller weighted to penetrate 4 inches evenly and solid to within 1½ inches of the top; then run a road grader or scarifier over entire surface lightly to make the street an even grade; then harrow and apply sufficient water; then apply the second coat of one fourth of the amount of oil to be used, evenly spread over entire surface of street; then harrow and tamp with tamping roller evenly and solid to top; then tamp gutters 18 inches wide out from curb with a wagon or truck weighted with 4 tons as hereinbefore specified. The work and material under this section to be done the full width of the street and over the oil base of gutter as specified in Section 3 of these specifications.

Wherever upon any street or alley, any cement crosswalks, cement gutters, or any paving and machine work is impracticable, then the same shall be done in same manner by hand work under the direction of the Superintendent of Streets.

The contractor will be held responsible for all damages to curbs, gutters, crosswalks, flumes, etc., that may be caused by him in the performance of the work. When water or oil is to be applied the condition of the soil shall be subject to the approval of the Superintendent of Streets. The contractor shall be required to examine all plans for the above work on file in the office or the city engineer.

(5) The quantity of crude oil to be applied to be 2½ gallons to every square yard of surface of heavy soil and 3 gallons for every square yard of light sandy soil, unless otherwise specified, from curb to curb, where there is no gutter, and where there are cement or paved gutters, then from gutter to gutter and at all intersection of streets and alleys to property line on both sides.

(6) The oil shall be from 12° to 14° gravity. Baumé test, at a temperature of 60° F., and contain not less than 70 per cent. of pure liquid asphaltum, natural non-processed oil, to be subject to the gasoline test for water and foreign matter, and not to contain over 2 per cent. of water or foreign matter, and heated to a temperature sufficient to run freely from a sprinkler or tank; provided, however, that in dry or dusty soil, 20 gallons of water must be used every 9 square feet of road surface before applying the oil. The contractor shall provide an analysis of oil furnished when called for by the street superintendent.

(7) To insure the quality and quantity of all oil used under these specifications, the contractor shall deliver said oil into the city's tanks at the corporation yard, there to be tested for gravity, water, and foreign substance, by the street superintendent or his assistant, whose duty it shall be, after said tests are made, to heat, measure and deliver said oil into such tank wagons as may be used to deliver and spread the oil on the street, and oil so handled at city tanks, shall be subject to a charge of — cents per barrel, said charge to be paid by the contractor to the city of Santa Monica. A complete record of all these transactions shall be kept by the street superintendent.

(8) All work shall be, in every respect, executed in a thorough and workmanlike manner, and shall be prosecuted and performed in sections, each section to be two blocks in length; provided, however, that whenever there is a street railroad operated and maintained upon any section, said work shall be so prosecuted and performed as not to interfere with the maintenance and operation of said track or tracks during the progress of said work.

(9) The contractor shall erect a fence and keep erected a proper barrier along the line of said work and across the ends of same both day and night, and maintain red lights between sunset and sunrise and post all legal notices and signals as to the state of the roadway or street during the prosecution of the work.

Reference is hereby made to the general specifications now in force for the grading of streets within the city of Santa Monica, including all ordinances, etc.

(10) The work shall be performed under the supervision of the city engineer and street superintendent. Also subject to the approval of the Board of Trustees of the city of Santa Monica, or their authorized agents.

[Thos. H. James, City Engineer, Santa Monica, Cal., Feb., 1907.]

From printed matter sent by Mr. James, it appears that this system of oiled roads has been used on a boulevard near Los Angeles, extending from the Soldiers' Home toward the ocean north of Santa Monica. The boulevard is 130 feet wide, with car tracks in the center. The portion of the boulevard treated was 56 feet in width and extended for a length of 18,000 feet. At Monrovia, Cal., 15 miles of oiled streets are in use and 10 are to be added. How closely these roads conform in mode of construction to those at Santa Monica we cannot say, but the inference from Mr. James' letter is that they are similar. From the statement regarding the Monrovia roads sent by Mr. James we learn that the specifications in use there have been gradually evolved by City Engineer J. H. McClymonds. The method differs widely from that generally employed elsewhere, in that it involves the use of a great deal of water, the roads being thoroughly soaked before the oil is applied, and again while the work is in progress. The finished highway looks like asphalt and often is mistaken for it. It is almost as hard and will endure for years under the heaviest travel.

A Texas Bill Respecting Oil and Petroleum Products.

A legislative measure creating the office of Inspector of Oil and Petroleum Products, which was placed before the consideration of the Texas Senate by Mr. Murray, has been reported favorably by the Senate Judiciary Committee, No. II. Under its mandates a flash test of 140° F. and a fire test of 160° are fixed as the standard in Texas, which now has no law governing the quality of oils to be sold within its borders.

It seems to have been established beyond question that the bill emanated from the agent of an Eastern concern which handles oils of high flash and fire tests. Such a standard as is proposed would make it practically impossible for the Texas refineries to supply a satisfactory burning oil, and would favor the dealers handling Eastern oils. While it is not charged that the Standard inspired the measure, it can hardly be gainsaid that its passage would favor that Company against the Texas refineries and its independent oil interests.

The Texas oils now being distributed to the trade in that State are usually of 115° to 120° flash and 125° to 130° fire test. These are considered very fair tests and up to the standard required in many other States which have legislated on the matter. To attempt to make an oil of much higher test from the Texas crude would result in impoverishing it by taking off nearly all of the lighter qualities. Such an oil could be made, but it would not give satisfaction to the consumer.

Mr. Murray admits that he was not informed as to the effect the bill would have if enacted into law. In fact, he professes entire innocence of the subject, stating that he introduced the measure at the request of one of his constituents.

The bill provides that where any incorporated city or town desires an

oil inspector the Council thereof shall petition the Governor, who shall appoint such inspector.

The same applies to counties through petitions by their commissioners' courts. It provides that the inspectors so appointed by the Governor shall be residents of the city and county, respectively, of their appointment, and must give bond in the sum of $2,000, with the privilege of appointing deputy inspectors.

The bill prescribes the tests for oils, etc., and the fees to be charged for inspecting and testing same. The oil inspected and found within the test shall be labeled "standard oil." If condemned it shall be officially labelled "unfit for illuminating purposes." Penalties are provided for violating the act and for selling oil condemned for illuminating purposes.

It also requires that labels or certificates of "standard oil" be destroyed upon the breaking of the barrel or package containing same, and provides a penalty for mixing oils or placing oil not inspected and approved in a barrel or other receptacle containing a mark of approval. The inspection fee is 12 cents a barrel for tests, etc., which shall be the ratio for oil inspected in bulk and sold in barrels, and 6 cents for small packages of oil.

Senator Murray says this bill is patterned after the Missouri statutes, except a raise in the test to correspond with the difference in latitude.

The Progress of Electrical Illumination.

[A paper by MR. J. W. COWLES, New England Illuminating Section Engineering Society.]

Some of us can remember back into the early 80's when the first commercial arc lamps were opened to the eyes of the public, and those of us who do remember them recall also what wonderful things they appeared to be. The pictures that I remember to have seen of the early Brush lamps and the first machine put on the market by the Brush Company were surely remarkable. The lamps, as I remember, appeared almost as large as the machine itself, and the lamps were certainly wonderful in that they opened up the way to a type of apparatus which very rapidly spread into innumerable styles and varieties. These lamps, though seemingly crude in the first stages, were very soon perfected and brought into commercial condition which gave excellent results. They were all of the open arc type, with clutch and clock-feed mechanism, but notwithstanding this and the comparatively crude quality of the carbons which were used, they brought forth results which from the standpoint of efficiency and watts per candle have hardly been equalled or surpassed until a very recent date. It was from these early lamps that we formed the somewhat bad habit of talking about 2,000 or 1,200-candle power. The open arcs, however, were essentially expensive in maintenance and open to serious objections from a commercial standpoint. The short life due to the rapid consumption of the carbons, necessitating trimming every day, made them expensive both in labor and material. For street service, the fact that they were open arcs, that is, that the carbons were exposed to the weather, made them subject to serious objection.

The inclosed arc came into the field about 1893, and although it had a hard road for the first few years, it was soon brought to a state of development which very rapidly put the open arc to rout.

Quite recently the pendulum has shown a tendency to swing the other way, and we are gradually getting back to the open arc principle, through the introduction of the so-called flaming arcs. These are strictly open arcs in that they are not inclosed in inner inclosing globes, and are true flaming arcs. The magnetite lamp of the General Electric Company has shown very marked advantages for outdoor illumination —street lighting particularly. The flaming arcs of the impregnated carbon type, such as the Excello, Siemens, etc., have come into extensive use. These lamps have appealed strongly to customers and the public, largely from an advertising standpoint. Our conscience allows us again to talk of 2,000-candle power, and even a good deal in excess of that figure, and the flaming arcs are certainly a wonderful step in advance in giving light for the money. All of these flaming arcs are outdoor lamps, since they all, to a greater or less extent, give off fumes which are somewhat objectionable for indoor use. The iron oxide fumes of the magnetite lamp make it strictly an outdoor lamp. The fumes of the Excello and the Siemens lamps, which at first were supposed to debar them wholly for indoor use, are gradually being found not to be so serious after all, and the flaming arcs of that type are being used indoors to some extent. I believe the experience is that inside inclosures large enough to require a volume of light, such as is given by the flaming arc, the fumes are not serious. These flaming arcs are inherently expensive to maintain. The carbons are treated with different chemicals or impregnated, giving different colored effects. The carbons are small in diameter, long in length, and short in life, all three conditions tending to make them expensive. They require practically daily trimming, after burning about 10 hours for most of the lamps, so that they are strictly short burning lamps. Other lamps which are in sight seem to bid fair to overcome these difficulties to some extent. The arc lamps, which until very recently have maintained an efficiency practically unequaled by the other means of electrical illumination, have since been obliged to meet close competition from the development of the incandescent units of larger size and higher efficiency, so that the field of the arc lamp now seems to be to some extent limited. I cannot bring myself to believe that the arc lamps are yet "down and out," as I have heard prophesied by others. I still believe that the arc lamp will hold a certain field of its own for a long time to come; and yet for a good many places, where arc lamps have been formerly used, they are quite out of the race to-day. The man with the small store, who formerly had one arc lamp in the center of his ceiling, should displace it as rapidly as he can by some of the more approved methods of incandescent lighting. Smaller units more evenly distributed, giving a more even distribution of his light and avoiding the objections which are always found in the case of large units prominently placed, must necessarily replace many arc lamps.

To the layman the incandescent lamp of years ago no doubt looked about the same as the lamp of to-day. The shape and dimensions are not materially different, and to the uninitiated the style or appearance of the filament and the essential features of the lamp are about as they were years ago. However, it is quite otherwise. The early lamps, of efficiencies which manufacturers would almost hesitate to acknowledge, went through the usual gradual process of improvement, the old, tedious, slow process of cutting the bamboo into strips, the treating process and the gradual preparing for service have been improved, and ingenious devices, better methods and, in fact, radical changes in details have been introduced, until to-day the manufacture of incandescent lamps is one of the most interesting processes. From the early lamps of unknown or unstated efficiency the lamp has been developed up to a 3.1-watt efficiency, and at this stage it has been considered the *par excellence* of lamp manufacture. The strides which were so rapid in the first few years unfortunately came nearly to a standstill, and for a number of years the improvements, at least in the matter of efficiency, were very slow, so that until quite recently we have felt quite content with a 3.1 watt efficiency.

Within the last two years, and more especially within the last year, the metal filaments have been brought out and are revolutionizing the lamp industry. The metalized filaments of the General Electric Company were practically forerunners of these types in commercial form, and this lamp, with a 2.5-watt efficiency, is now being rapidly put into service. The lamp partakes very much of the old carbon filament nature.

The tantalum lamp was the next of the high efficiency lamps to be introduced commercially, This lamp, with a rating of 22-candle power at 44 watts, or 2 watts per candle, gives a very satisfactory light. With the increase in efficiency, of course, we get an improvement in the color, a whiter light, and we are getting nearer a pure white light, or at least getting farther away from the yellow color which has been such a handicap to the old carbon filament lamps. The tantalum lamp is now being introduced extensively. The retail price of the lamp is approximately 60 cents. The Boston Edison Company offers it on a renewal basis with an excess charge, the customer paying 30 cents wherever he would be entitled to a carbon lamp free. The great handicap on this lamp is that it is essentially a direct current lamp. On direct current the life is supposed to be about 700 hours. On alternating current, unfortunately, the life is very short, due to a molecular disintegration of the filament, which, so far as I know, is not fully understood yet. With alternating current the life is considerably less than 300, probably not much over 250.

The next lamp in order, though not yet in commercial form, is the tungsten lamp. The beauty of this lamp is not only in its high efficiency, getting down to practically 1¼ watts per candle, but it is interchangeable between alternating and direct current, and equally good on both, and with a life which promises to equal or exceed the present carbon 3.1 watt lamp and even the tantalum lamp. All of these metal filament lamps have one inherent valuable feature; they all have the positive coefficient of resistance of metals. The carbon filament has a very decided negative resistance coefficient, the resistance decreasing rapidly with increased temperature, so that the resistance of the lamp at the temperature usually burned is about half the normal resistance

of the lamp cold, whereas the metallic filaments show the reverse, that is, with increased temperature we get increased resistance. This plays an important part, giving to a considerable degree, an inherent automatic means of regulation, thus making the lamp much less sensitive to fluctuations and variations in voltage, so that the detrimental or deteriorating effect on the lamp of excess voltage is very much less than with the carbon filament lamp.

There has been, along with the development of the high efficiency lamp, an extensive development in shades, so that fortunately the question of the proper shades and the proper distribution of the light from the lamp is receiving attention to-day which has been woefully lacking in past years.

In a little different line of lighting, perhaps not strictly classed as incandescent lighting, is the Nernst lamp. This has been on the market for a number of years, has built up an important business and given good service. It has a field of its own. These lamps are manufactured in standard sizes of 1, 2, 3, 4 and 6 glowers, taking approximately 90 watts at 220 volts per glower. The Nernst lamp, however, has a handicap similar to that of the tantalum lamp, only in an inverse direction. The Nernst lamp is inherently an alternating current lamp and, furthermore, is confined practically to 220 volts.

One of the newest and most interesting of the later developments in electric lamps is the vapor lamp, such as the Cooper-Hewitt and the Moore vacuum tube lamps, which are coming into service to quite an extent. The mercury vapor lamp is operated upon either alternating or direct current—not exactly the same lamp—however, in units of approximately 300 to 400 candle power, burned as a rule in series of 2 across 110 or 4 in series across 220 volts, although single lamps for 110 volts are obtainable These lamps give a watt efficiency which surpasses anything obtainable before, reaching a figure as low as ½ of a watt per candle, and figures even lower than this seem to have been well established. They give a good power factor, only slightly less than unity and wherever they can be used, taking into consideration their peculiar color, they are giving excellent results. For photographic work they are excellent.

The other type of lamp to which I have referred is the Moore vacuum tube lamp. The Moore vacuum tubes are practically little else than commercialized Geisler tubes. They give a method of lighting which promises to be most attractive. This lamp is essentially an alternating current lamp, and is simply a high voltage discharge through a tube filled with rarefied gases of different kinds, so that it is simplicity itself. The whole equipment consists simply of the tube, made into whatever form may be desired, with both ends entering into a cabinet in which is a transformer, the primary of the transformer being connected to the commercial alternating current service. These lamps give an efficiency of about 1.5 watts per candle and are readily available in lengths from one up to several hundred feet, if necessary. It is simply a problem of glass welding to get tubes of practically any length. The usual practice is to run the tubes at an intensity of about 12-candle power, or 18 watts, per foot of tube, although 20-candle power per foot is easily possible.

Aids to Progress in Lighting.

[A paper read by MR. J. S. CODMAN, New England Section, Illuminating Engineering Society.]

The illuminating engineer is now getting assistance which he did not get several years ago, which makes it a great deal easier for him to do scientific work. About 6 or 7 years ago the average layman had no idea that a 16-candle power lamp did not give 16 candles in every direction. I think that was also true of a great many electrical men, or if it was not actually true, they did not think much about it. In general there was an absolute lack of recognition of the importance of the distribution of candle power about a source of light. I think that was also true of the gas people. About that time a certain lamp appeared on the market, and it happened that this lamp was so designed that the filament was horizontal and had behind it a pretty good reflecting surface and had a very high downward candle power. I do not know whether it was designed to give that or whether that was an incident of the design, but I do know that the lamp was put on the market and rated on the downward candle power, and the downward candle power of some of these lamps was 50. The lamp took 88 watts and the efficiency appeared to be 1.76 watts per candle. Now, it did not take long for some bright mind to conceive the idea of putting an ordinary reflector on an incandescent lamp, putting it on the market and rating it on the downward candle power as a new unit of light. This idea was followed up in another type of lamp, having the lower part frosted and a reflector behind it. The first reflectors put out were aluminum, but they were replaced by glass reflectors. These two lamps, in spite of the exaggerated claims for them when they were first put out, were, as a matter of fact, a great advance aside from their efficiency, which was not really anything astonishing. They were an advance in other ways, but one thing in particular they did accomplish: They opened the eyes of the public to the fact that the rated candle power was of very little importance, and that we must know the light distribution in order to understand the amount of light being given. At that time distribution curves were practically unknown. Nowadays we have photometric curves, and a great many manufacturers of incandescent lamps, globes and reflectors publish distribution curves which are of great aid to the illuminating engineer. A great many of these curves are to be found published in the transactions of societies and in the technical papers. There was a paper read before the Western Gas Association last year, in which there were 24 photometric curves given of various gas mantles, with all sorts of miscellaneous shades.

Then there is another thing that was needed to make the work of the illuminating engineer easier, and that was some sort of convenient tables. A great deal of work is being done by illuminating engineers using the law of inverse squares in their calculations. Something was needed to save all this trouble, and the majority of engineers now, I think, use various tables of their own, but nothing had been published until recently there appeared a set of tables called "King's Illumination Tables," which I think will be of considerable assistance. They are the first thing of the kind I think ever published and will be found very useful.

Recent Patent Issues.

[Prepared by MR. ROYAL E. BURNHAM, Solicitor of Patents and Counsellor in Patent Cases, 833 Bond Building, Washington, D. C., who will furnish illustrations and specifications of any patent mentioned below on receipt of 10 cents.]

838,022. Acetylene gas generator. P. O. Hays, Gainesville, Tex.

838,049. Means for drawing and loading coke. W. M. Nixon, Chattanooga, Tenn.

838,080. Machine for incinerating, baking and shaping incandescent gas light mantles. C. Clamond, Paris, France.

838,156. Gas burner. F. M. Ashley, New York city, assignor of one-half to A. T. Scharps, same place.

838,239. Self-lighting attachment for gas burners. F. Chipault, New York city, assignor to J. L. Wolf, same place.

838,447. Gas apparatus. J. A. Perry, Philadelphia, Pa., assignor to the United Gas Improvement Company, same place.

838,596. Gas heater. E. G. Van Zandt, St. Louis, Mo.

838,633. Device for regulating the quality of gas. C. Matthews, Jr., Chicago, Ills.

838,634. Device for regulating the quality of gas. C. Matthews, Jr., Chicago, Ills.

838,685. Gas lighting attachment. W. B. Carrick, Chicago, Ills.

838,712. Apparatus for washing and scrubbing gas. S. Hersey, London, England, assignor to Kirkham, Hulett & Chandler, Ltd., Westminster, London, England.

838,805. Apparatus for carburetting gas. L. C. Parker, St. Joseph, Mo.

838,936. Gas heating stove. B. C. Bartlebaugh, Benwood, W. Va.

838,946. Gas producer. W. H. Bradley, Bellevue, Pa., assignor of one-fourth to A. Gilliland, one-fourth to W. C. Bradley, Bellevue, Pa., one-eighth to M. E. Webster, Chicago, Ills., and one-eighth to S. L. Bradley, St. Louis, Mo.

839,032. Gas burner. A. J. Quinlan, Akron, O.

839,392. Water meter. J. P. Kelly, Worcester, Mass.

839,428. Acetylene gas generator. J. M. Scriven and C. F. Baer, Lucas, Kas.

839,454. Burner. A. B. Clunies, Rochester, N. Y., assignor to Sill Stove Works.

839,459. Process of making gas. H. Dicke, Frankfort-on-the-Main, Germany, assignor to J. E. Goldschmid, same place.

839,798. Process of producing gas for power purposes. F. W. Barker, Nyack, and T. L. White, New York city, assignor of one-tenth to J. F. Coffin, New York city.

839,565 Feed mechanism for acetylene gas generators. A. C. Einstein, St. Louis, Mo.

839,774. Street lamp lighting and extinguishing system. G. Lentschat, Hohenschonhausen, near Berlin, Germany.

839,927. Record slip for meters. G. E. Hawkins, Columbus, O.

839,939. Apparatus for making gas and coking. L. P. Lowe, San Francisco, Cal.

839,940. Apparatus for recovering from oil its tarry and asphaltic constituents, with gas as a by-product. L. P. Lowe, San Francisco, Cal.

840,092. Gas burner. P. Seiler, Chicago, Ills.

840,097. Acetylene gas generator. C. W. Waymire, Norwalk, Cal.

840,115. Gas generator. J. D. Dawson, Beardstown, Ills.

840,361. Acetylene generator. A. G. Odell, Milan, O.

840,445. Combined gas seal box and washer. I. N. Enright, San Francisco, Cal.

840,447. Gas producer. P. Eyermann, Dubois, Pa.

840,461. Process of manufacturing producer gas. W. H. Adams and F. Powell, Portland, Ore.

840,552. Apparatus for generating acetylene. C. Billy, Paris, France.

840,586. Street lamp. F. Rech, Ehrenfeld, Germany.

840,772. Automatic safety valve for gas supply pipes. A. W. Jenczewsky, Chicago, Ills.

840,795. Apparatus for regulating gas ports. R. W. Oakman, New York city.

840,796. Gas controlling device. R. N. Oakman, New York city.

840,831. Gas burner. J. Doorenbos, Kalamazoo, Mich.

841,100. Gas producer. C. J. Atkinson, Milwaukee, Wis.

841,123. Gas producer. H. K. Cowen, Chicago, Ills.

841,148. Acetylene gas generator. A. H. Herbert, Holyoke, Mass.

841,196. Anti-pulsator for gas conduits. T. Thorp, Whitefield, England.

841,203. Incandescent gas lamp. O. Wiederhold, Jersey City, N. J.

841,204. Means for protecting and applying incandescent mantles. O. Wiederhold, Jersey City, N. J.

841,323. Gas lamp. A. H. Humphrey, New York city.

841,400. Gas burner and automatic cut off therefor. L. Holtschneider, Jefferson City, Mo.

841,410 Rotary water meter. C. A. Lockwood, New York city.

841,466. Gas generating retort. T. L. Stewart, Oakland, Cal.

841,499. Process of manufacturing power gas. E. Fleischer, Dresden-Strehlen, Germany.

841,618. Apparatus for measuring gas pressures. P. de Bruyn, Dusseldorf, Germany.

842,259. Automatic gas lighting and extingishing apparatus. N. H. Shaw, Boston, Mass.

842,334. Gas burner. P. E Peterson, Milford, N. H.

842,345. Acetylene gas generator. B. W. Scott, San Jose, Cal.

842,427. Gas furnace. H. A. Schnelbach, Pittsburgh, Pa.

842,792. Gas burner. G. Machlet, Jr., Elizabeth, N. J.

Design 34,431. Gas lamp. R. W. Zierlien, St. Louis, Mo.

Design 38,432. Lamp. O. Helfft, Berlin, Germany.

Design 38,433. Incandescent lamp. O. Helfft, Berlin, Germany.

Design 38,434. Incandescent lamp. O. Helfft, Berlin, Germany.

842,887. Gas burner regulator. W. C. Homan, Meriden, Conn.

842,962. Acetylene gas generator. G. Laporte, St. Felix de Valois, Quebec, Canada.

842,975. Mantle support. F. E. Reichardt, Chicago, Ills.

843,079. Process of enriching blast furnace gas. C. Ellis, White Plains, N. Y.

843,289. Acetylene carbonic acid derivative. C. Moureu, Paris, France.

843,290. Acetylene carbonic acid derivative. C. Moureu, Paris, France.

843,379. Incandescent gas burner. F. T. Williams, Meriden, Conn.

843,429. Acetylene generator. T. Babin and J. Colomb, Houma, La.

843,474. Gas light. H. W. Manning, Portland, Ore.

843,524. Process of revivifying gas purifying materials. H. L. Doherty, Madison, Wis.

843,644. Gas stove. E. G. Van Wie, Detroit, Mich.

843,669. Appparatus for producing gas. C. Ellis, New York city.

843,715. Gas generating apparatus. G. M. S. Tait, Montclair, N. J.

843,787. Gas producer. C. J. Atkinson, Milwaukee, Wis.

843,903. Incandescent gas lamp bulb. C. M. Lungren, Bayonne, N. J.

844,047. Acetylene gas generator. E. M. Rosenbluth, Phila., Pa.

844,060. Machine for reviving gas wells. W. D.Van Arsdale and D. R. Spearman, Pendleton, Ind.

844,312. Gas washer. F. E. Bachman, Port Henry, N. Y.

844,313. Gas washer. F. E. Bachman, Port Henry, N. Y.

844,358. Gas controlling valve. H. W. Hill, Chicago, Ills.

844,504. Apparatus for regulating combustion in furnaces. H. L. Doherty, Madison, Wis.

844,606. Acetylene gas generator. S. M. Meyer, New York city.

844,607. Acetylene lamp. S. M. Meyer, New York city.

844,608. Lamp for automobiles and other vehicles. S. M. Meyer, New York city.

844,609. Acetylene gas generator. S. M. Meyer, New York city.

844,610. Electric lighting apparatus for incandescent and other gas lamps. S. M. Meyer, New York city.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

THE residents of Easthampton, Mass., are "pointing with pride" to the new offices of the local Gas Company, which neat show room was opened for active work last month.

THE net gas rate at Cohoes, N. Y., of $1.30 per 1,000 cubic feet, is now operative.

JUST prior to his retiring from the construction force of the Auburn (N. Y.) Gas Company, Mr. Denis V. Harrington was presented with a gold timepiece by his former employees. The presentation speech was made by the Manager of the Company, Mr. Coleman, and the response thereto by Mr. Harrington was in that active gentleman's best tenses.

THE Grand Jury that examined the details of the defalcation or misuse of the funds of the Dayton (O.) Gas Company, returned a true bill covering 18 indictments against ex-Secretary George M. Smart, charging him with the embezzling of a sum of $331,348. When the trial of this cause comes on it will likely be found that Mr. Smart was, to say the least, not altogether to blame for the miserable mess.

THE Beverly (Mass.) Gas and Electric Light Company has arranged for a considerable addition to its generating house.

MANAGER C. E. GROESBECK, of the San Diego (Cal.) Gas and Electric Company, is our authority for the statement that in 1906 the sum of $780,000 was expended on all divisions of the plant.

THE mix-up in the affairs of the Western Investment Company, of Chicago, which resulted in the placing of the business of the Rochester (Minn.) Gas Company in the hands of a receiver, does not mean that that plant is to be shut down.

THE La Crosse Gas and Electric Company and the Wisconsin Light and Power Company, both of La Crosse, Wis., have joined forces, thus ending a long drawn out contest.

WITH much regret we announce the death of Mr. W. Riley Deeble, who died at his home, 2,020 P street, Washington, D. C., the morning of the 4th inst. Deceased was born in Georgetown, D. C., April 21st, 1860, and since his 17th year was actively interested in the development of Georgetown, which is truly indebted to him for his well-directed and successful efforts in its behalf. He was prominent in the local, insurance and financial divisions of Washington's development, and was also an expert in real estate values all over the District of Columbia. He was President of the Georgetown Gas Light Company, having, if we err not, succeeded in that position the late Mr. Leetch. He is survived by his widow, 3 daughters and a son.

SOME days ago 20 laborers on the pipe force of the Louisville (Ky.) Gas Company quit work on the refusal of the Company to raise the wage rate from $1.60 to $1.75 per day.

MR. H. J. W. Carbray has been appointed Sales and Claim Agent for the Montreal (Can.) Light, Heat and Power Company.

MESSRS. HARRISON, Gay and Danzler, of Biloxi, Miss., have been granted a franchise for the operation of a gas works in Bessemer, Ala.

MR. MARK HAZEL, of Jacksonville, Fla., has been appointed Superintendent of the gas and ice making plants at Pine Bluff, Ark.

AT the annual meeting of the Cadillac (Mich.) Gas Light Company the officers elected were: President, E. A. Stowe; Vice-President, George D. Van Vranken; Secretary, Guy W. Rouse; Treasurer, Ralph S. Child.

A SERIOUS conflagration in the power house of the San Francisco Gas and Electric Company the evening of the 2d inst. caused great confusion and much monetary loss. The electric service in several sections of the city was greatly interrupted.

WE are informed that Mr. Frank E. Robinson has been appointed Manager of the Aurora division of the service of the Western United Gas and Electric Company, vice Mr. David Elder, resigned.

WE are indebted to the courtesy of Mr. Henry Crowther for a copy of the new High Pressure Fire Service booklet recently issued by Messrs. R. D. Wood & Co. It will be mailed on request forwarded to the Company's offices, 400 Chestnut street, Philadelphia, Pa.

WRITE to Mr. Philip Cross, Commercial Manager for the Denver (Col.) Gas and Electric Company, for an outline of his very clever way of calling attention to the installing of a "Model Kitchen." Mr. Cross is certainly a clever formulator of ways and means for securing the consideration of the housekeepers.

MR. WM. J. CLARK, Superintendent of the General Fuel Appliance Department of the Consolidated Gas Company, of New York, has also brought out some new literature tending to call to the mind of the flat dweller in New York how convenient and comfortable it is to have a gas water heater in use during the hot season. At the moment (Tuesday) it looks a bit out of place to allude to this scheme of Mr. Clark's; but, "To-morrow the sun may be shining, although it is snowing to-day."

THE Hon. Oscar Edwards, one of the organizers of the Northampton (Mass.) Gas Light Company, died at his home in that city, March 31st. He was born in Chesterfield, Mass., June 6, 1821, and became a resident of Northampton in the spring of 1852. To repeat the story of his life would be like narrating every phase of life in Northampton for the last 50 years. No other man in Northampton was more respected and liked.

THE imperturbable but wideawake Capt. McGregor, of the Pawtucket (R. I.) Gas Company, is considering the advisability of opening a bureau

for the pacification of customers who complain that their gas bills are too small. His thoughts were turned in this direction by the remark of a customer who, on settling his March gas account, said positively that he was sure the Company had not charged him for all the gas used in his home between the dates specified in the bill.

THE Los Angeles (Cal.) Gas Company has authorized Messrs. Parkinson & Bergstrom, a well-known local firm of architects, to draw plans for the reconstruction of its buildings on South Alameda street.

THE Gas Bench Construction Company, of St. Louis, Mo., has awarded the contract for installing the generating end of the new coal gas plant which the Lansing (Mich.) Fuel and Gas Company is to erect. The contract calls for the placing of 10 benches of 6's, over full depth recuperators.

MR. J. G. EHRENFIELD has assumed the duties connected with his appointment as Superintendent of the Fayette County (Pa.) Gas Company.

MR. AND MRS. NORMAN G. KENAN are home again, after a very delightful trip to the West Indies. Mrs. Kenan, however, thinks openly that New York (next to Cincinnati, of course), is the greatest touring ground in the wide world. To be sure, Mr. Kenan agrees with her.

MR. O. J. HILL has been appointed Manager of the Addison (N. Y.) Gas and Power Company, vice Mr. Miles T. Cassada. He takes charge the 20th inst.

JAMES DEMO, a young colored thief was recently convicted of robbing prepayment meters in the homes of three residents of New Haven, Conn. In the residence of Mr. D. S. Berger, Demo so injured the meter that the lives of the occupants were endangered by a serious escape of gas. The sentence was a fine of $110, a stay in jail of 220 days, and costs of $13.10.

MR. JAMES W. DUNBAR, of New Albany, Ind., and his associates, are to be congratulated over the success that attended their efforts in causing the defeat of measures proposed by the Indiana State Legislature for the harassing of the gas industry. Prominent in the bunch of "strikers" was a bill ordering that the maximum gas rate in any part of the State should not exceed 90 cents per 1,000 cubic feet. If we mistake not, before Messrs. Dunbar & Co. got on the scene, this bill had been passed by the Senate.

THE Mattoon (Ills.) Gas Company the last week in March gave a dinner to its employees, which spread was under the immediate direction of Manager Goss. The latter's address on the relationship of employer and employee to the consumer was quite a clever speech. Mr. W. J. Knott's contribution to the session was quite a lucid description of the construction and management of the new benches now in successful operation in the Company's generating division, and Mr. C. J. Wilder outlined several new business methods. Mr. Wilder's part in the proceedings was a multi one, for after his speech he broiled a beefsteak on a gas range, in full view and smelling distance of the guests, and during and after the absorption of the steak, etc., he put forth some musical numbers that were provocative of applause.

WRITE to the Green Fuel Economizer Company, of Matteawan, N. Y., for a copy of its newest catalogue telling how to save 15 per cent. of the coal in making water gas. The designers of this catalogue (the Geo. H. Gibson Company) deserve great credit for the style in which they put the brochure together.

THE resignation of Mr. Arthur T. Nicholson, as Manager of the Palmyra (N. Y.) Gas and Electric Company, became effective the 1st inst.

THE incorporation of the Beaumont (Tex.) Gas Light Company, with a capitalization of $750,000, has been announced. The incorporators are August A. Hauser and Morris Levy, of Beaumont, and Harry B. Hurd, of Chicago.

MR. SAMUEL P. HUNT, son of Judge Nathan P. Hunt, of Manchester, N. H., has been appointed Assistant General Manager of the Manchester Traction, Light and Power Company. Mr. Hunt, who is a graduate of the Massachusetts Institute of Technology, will act as assistant to the Company's General Manager, Mr. J. Brodie Smith.

MRS. HELEN ARMSTRONG is now giving on behalf of the Indianapolis (Ind.) Gas Company a series of demonstration lectures on how and what to cook with gas. These lectures are to last through the month, and are to be given in 21 different churches of the city. The demonstration commences at 2:30 P.M. each day.

MR. W. S. BEAUPRE, President of the Aurora (Ills.) National Bank, one of the new Directors in the Aurora Gas and Light Company, is a brother of that prince of men, Mr. C. E. Beaupre, of De Kalb, Ills. He is pretty good, too.

THE Portsmouth (Va.) Gas Company has acceeded to Superintendent Ferguson's appeal that sensible additions to the Company's main system be arranged for.

THE annual meeting of the Columbus (O.) Gas and Fuel Company will be held in that city the 1st prox. The growth of the Company's business was remarkable during the twelvemonth, but great as it was there is no doubt that the increase for 1907 will be even greater. Under the circumstances there is no likelihood of any change in the executive management.

THE concession in gas rates ordered by the St. Clair County Gas and Electric Company, as to its Belleville (Ills.) division, becomes operative May 1st. Under the schedule the gross is reduced to $1.25 per 1,000 cubic feet with a rebate of 10 cents per 1.000 on accounts settled in 10 days after presentation.

ON the 4th inst. a writ of mandamus was granted by Supreme Court Justice Crane in favor of the Flatbush (L. I.) Gas Company, ordering the Department of Water Supply, Gas and Electricity to permit the Company to open Ocean Parkway at Avenue I, so that it may lay its electric wires from its mains to the subway conduits.

THE Metropolitan Light and Power Company, which was formerly known as the San Francisco (Cal.) Coke and Gas Company, has increased its bonded indebtedness to $7,000,000. Mr. Leopold Michels continues to preside over the concern.

IT does not seem likely that anything of moment will speedily result from the city's agitation of the matter to purchase the plant and possessions of the Toronto Electric Light Company for operation on public account.

THE municipal gas plant at Morning Sun, Ia., is a dismal failure. The selling rate was advanced to $1 per 1,000 cubic feet last month. Bring experts Adams, Bemis and Marks out that way. They are the sure enough doctors in showing how gas can be profitably sold at a price that only covers the cost of labor and raw materials.

MR. ALBERT J. MILLER, since 1892 Secretary and Treasurer of the Galveston (Tex.) Gas Company, has resigned from its service. His successor is Mr. Charles S. French, who has been on the Company's staff for 14 years. Mr. Miller proposes to make his residence hereafter in Paris, Ills., which handsome little city, if we mistake not, was his birthplace.

WE understand that the cost of the proposed new gas plant for Ogden, Utah, which is to be constructed by the Utah Light and Railway Company, will be not less than $250,000.

THE authorities of Wilmington, N. C., are dickering with the Fayetteville Gas and Electric Company for the transfer thereto of the municipal electric lighting plant.

A CORRESPONDENT in Providence, R. I., writing under date of the 8th inst., ineloses the following: "The Welsbach Company has opened a store here, located on the premises 365 Westminster street. The formal opening thereof was made the afternoon and evening of the 30th ult., the opening hour having been set for noon. From then till the closing hour in the evening a steady stream of people poured into the establishment, thousands of people visiting the new store. Nothing was sold, the opening day being devoted entirely to getting acquainted with prospective customers and showing them the elaborate display of every kind of light for home and office use. Every woman and girl that visited the store received a rose, while the men and boys got paper cutters. The interior of the store was beautifully decorated with flowers and potted plants and presented a very attractive appearance. Another feature of the opening day was the music rendered by Fay's Orchestra, Messrs. Church and Suary, soloists, sung from a balcony in the rear of the store. All kinds of lights were on display. The firm invites everyone to come to the store and look over the various lights and have the workings of each light explained."

THE AMERICAN GAS LIGHT JOURNAL

A. M. CALLENDER & CO.,
PROPRIETORS.

THOS. J. CUNNINGHAM,
ELBERT P. CALLENDER,
EDITORS.

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THE JOURNAL is the official organ of the
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NOTIFICATION RESPECTING ADVERTISING.

Orders for new advertising, or for changes in standing advertisements, to insure attention in the issue following their reception, must be in hand any time of Wednesday.

AGENTS:

New York—American News Co., 39 and 41 Chambers St.
Germany—Lemcke & Buechner, of New York.
England—Aug. Siegle, 30 Lime Street, London.

MONDAY, APRIL 15, 1907.

The Market for Gas Securities.

Returning reason appears ready for an inning, and the gentlemen who go in for the short side are evidently having a rough time of it in seeking that shelter which covering implies. The net gain in Consolidated for the week figures out at 12 points in the rough, which may be accounted a reasonable move. About 150 looks sure for the stock by June 1st. Speculators must not take for granted that the 80-cent gas bill will be pronounced constitutional in the court of last resort. Indeed, the reverse is measureably sure to be the case.

Brooklyn Union appears to present more than favorable opportunity for a good round turn, at anything under 120. Peoples, of Chicago, is virtually 93, and we renew our advice respecting Massachusetts Gas Companies.

Gas Stocks.

Quotations by George W. Close, Broker and Dealer in Gas Stocks.

16 WALL STREET, NEW YORK CITY.

APRIL 15.

☞ All communications will receive particular attention.

☞ The following quotations are based on the par value of $100 per share.

N. Y. City Companies	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated	$73,177,000	100	131¼	131⅛
Central Union Gas Co.—				
1st 5's, due 1972, J. & J.	3,000,000	1,000	101	104
Equitable Gas Light Co.—				
Con. 5's, due 1932, M. & S.	1,000,000	1,000	..	105
Mutual	3,500,000	100	190	225
New Amsterdam Gas Co.—				
1st Con. 5's, due 1948, J. & J.	11,000 000	1,000	95	98
New York & Richmond Gas Co. (Staten Island)	1,500,000	100	37	43
1st Mtg. Gold Bds. 5 p.ct.	1,000,000	..	98	104
Northern Union—				
1st 5's, due 1927, J. & J.	1,250,000	1,000	101	103
New York and East River—				
1st 5's, due 1944, J. & J.	3,500,000	1,000	108	111
Con 5's, due 1945, J. & J.	1,500,000	..	104	110
Standard	5,000,000	100	140	160
Preferred	5,000,000	100	155	175
1st Mtg. 5's, due 1930, M. & N	1,500,000	1,000	104	108
The Brooklyn Union	15,000,000	1,000	110	120
1st Con. 5's, due 1948, M. & N	15,000,000		107	..
Yonkers	299,650	500	130	..
Out-of-Town Companies.				
Bay State	50,000,000	50	¼	⅜
" Income Bonds	2,000,000	1,000	..	75
Binghamton Gas Works	450,000	100	..	65
" 1st Mtg. 5's	509,000	1,000	95	100
Boston United Gas Co.—				
1st Series S. F. Trust	7,000,000	1,000	82	85
2d " " "	3,000.000	1,000	47½	50
Buffalo City Gas Co.	5,500,000	100	9	10
" " Bonds, 5's	5,250,000	1,000	75	80
Capital, Sacramento	500,000	50	..	35
Bonds (6's)	150,000	1,000	..	..
Chicago Gas Co. Guaranteed Gold Bonds	7,650,000	1,000	104	106¾
Cincinnati Gas and Electric Co.	29,500,000	100	99¼	99¾
Columbus (O.) Gas Co., 1st Mortgage Bonds	1,500,000	1,000	90	..
Columbus (O.) Gas Lt. & Heating Co	1,682,750	100	87	88
Preferred	3,026,500	100	107½	108
Consumers, Toronto	2,300,000	50	200	204
Consolidated, Baltimore	11,000,000	100	.	90
Mortgage, 6's	3,600,000	..	..	118
Chesapeake, 1st 6's	1,000,000	..	..	..
Equitable, 1st 6's	910,000	..	..	..
Consolidated, 1st 5's	1,490 000	..	..	112
Consolidated Gas Co. of N. J.	1,000,000	100	15	17
Con. Mtg. 5's	880,000	1,000	92	95
Bonds	75,000	..	..	100
Detroit City Gas Co	5,000,000	50	..	50
" Prior Lien 5's	4,618,000	1,000	..	98
Detroit Gas Co., 5's	381,000	1,000	75	80
" Inc. 5's	16,000	100	98½	100
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	..	101
Essex and Hudson Gas Co.	6,500,000	..	39	40
Fort Wayne	2,000,000	..	..	..
" Bonds	2,000,000	..	55	..
Grand Rapids Gas Lt. Co. 1st Mtg. 5's	1,225,000	1,000	104½	105
Hartford	750,000	25	190	200
Hudson County Gas Co., of New Jersey	10,500,000	..	110	112
Bonds, 5's	10,500,000	..	107½	108½
Indianapolis	2,000,000	..	60	70
" Bonds, 5's	2,650,000	..	104½	105
Jackson Gas Co	250,000	50	82	..
" 1st Mtg. 5's	290,000	1,000	97	100
Kansas City Gas Light Co., of Missouri	5,000,000	100	..	36
Bonds, 1st 5's	3,822,000	1,000	102	104
Laclede, St. Louis	10,000,000	100	..	05
Preferred	2,500,000	100	95	110
Bonds	10,000,000	1,000	104	104¼
Lafayette Gas Co., Ind.	1,000,000	100	..	60
Bonds	1,000,000	1,000	60	65
Louisville	2,570,000	50	143	145
Madison Gas & Elec. Co.				
" 1st Mtg. 6's	350,000	1,000	106	108¾
" 6 per cent. scrip, due 1910	100,000	25	85	87
Massachusetts Gas Companies of Boston	25,000,000	100	62	62¼
Preferred	25,000,000	100	85	85⅛
Montreal, Canada	2,000,000	100	218	218¾
Nashville Gas Lt. Co.	1,000,000	100	110	..
Newark, N. J., Con. Gas Co.	6,000,000	..	56	58
Bonds, 6's	6,000,000	..	137	138
New Haven	2,000,000	25	200	..
Peoples G. L. & Coke Co., of Chicago	25,000,000	100	92⅜	93
Peoples Gas Lt. & Coke Co., Chicago, 1st Mortgage	20,100,000	1,000	..	..
" 2d "	2,500,000	1,000	104	..
Rochester Gas & Elec. Co.	2,150,000	50	88	..
Preferred	2,150,000	50	118	..
Consolidated 5's	2,000,000	..	104⅛	105¼
San Francisco, Cal.	15,800,000	100	..	..
St. Joseph Gas Co. 1st Mtg. 5's	751,000	1,000	92	..
St. Paul Gas Light Co	1,500,000	100	45	47
1st Mortgage 6's	650,000	1,000	113	116
Extension, 6's	600,000	1,000	112½	115
General Mortgage, 5's	2,465,000	1,000	96¼	..
Syracuse, N. Y.	1,975,000	100	50	55
Bonds	2,047 000	1,000	102	..
Washington, D. C	2,500,000	20	292½	300
First mortgage 6's	600,000	..	..	..
Western, Milwaukee	4,000,000	..	..	..
Wilmington, Del.	600,000	50	230	..

Advertisers' Index

GAS ENGINEERS. Page

A. E. Boardman, New York City 641
Baxter & Young, Detroit, Mich 651
B. E. Chollar, St. Louis, Mo 644
Cruse-Kemper Co., Philadelphia, Pa 640
Davis & Farnum Mfg. Co., Waltham, Mass 652
Economical Gas Apparatus Construc'n Co., Toronto, Ont 651
Frank D. Moses, Trenton, N. J 652
Frederic Egner, Norfolk, Va 656
H. M. Byllesby & Co., Chicago, Ills 639
Humphreys & Glasgow, New York City 652
Isbell-Porter Co., Newark, N J 640
J. F. W. Jost, Philadelphia, Pa 656
Kerr Murray Mfg. Co., Fort Wayne, Ind 653
Practical Gas Construction Co., North Chicago, Ills. 633
The Gas Machinery Co., Cleveland, O 636
The Jeffrey Manufacturing Co., Columbus, O 650
United Gas Improvement Co., Philadelphia, Pa 647
Western Gas Construction Co., Fort Wayne, Ind. 660

GAS WORKS APPARATUS AND CONSTRUCTION.

A. E. Boardman, New York City 641
Bartlett, Hayward & Co., Baltimore, Md 653
Baxter & Young, Detroit, Mich 651
Connelly Iron Sponge & Governor Co., New York City 649
Continental Iron Works, Brooklyn, N. Y 654
Cruse-Kemper Co., Philadelphia, Pa 640
Davis & Farnum Mfg. Co., Waltham, Mass 652
Deily & Fowler, Philadelphia, Pa 656
Economical Gas Apparatus Construc'n Co., Toronto, Ont. 651
Frank D. Moses, Trenton, N. J 652
Humphreys & Glasgow, New York City 652
Isbell-Porter Company, New York City 640
Kerr Murray Mfg. Co., Fort Wayne, Ind 653
Lloyd Construction Co., Detroit, Mich 642
Logan Iron Works, Brooklyn, N. Y 656
Quintard Iron Works, New York City 652
R. D. Wood & Co., Philadelphia, Pa 654
Riter-Conley Mfg. Co., Pittsburgh, Pa 655
Stacey Mfg. Co., Cincinnati, O 655
The Gas Machinery Co., Cleveland, O 636
The Jeffrey Manufacturing Co., Columbus, O 650
United Gas Improvement Co., Philadelphia, Pa 647
Western Gas Construction Co., Fort Wayne, Ind 660

PROCESSES.

Bartlett, Hayward & Co., Baltimore, Md 653
B. E. Chollar, St. Louis, Mo 644
Economical Gas Apparatus Construc'n Co, Toronto, Ont. 651
Humphreys & Glasgow, New York City 652
Semet-Solvay Co., Syracuse, N. Y 690
The Gas Machinery Co., Cleveland, O 636
United Gas Improvement Co., Philadelphia, Pa 647
Western Gas Construction Co., Fort Wayne, Ind 660

SCRUBBERS AND CONDENSERS.

Continental Iron Works, Brooklyn, N. Y 654
Cruse-Kemper Co., Philadelphia, Pa 640
Davis & Farnum Mfg. Co., Waltham, Mass. 652
Economical Gas Apparatus Construc'n Co., Toronto, Ont 651
Isbell-Porter Co., Newark, N. J 640
Kerr Murray Mfg. Co., Fort Wayne, Ind 653
Logan Iron Works, Brooklyn, N. Y 656
R. D. Wood & Co., Philadelphia, Pa 654
Riter-Conley Mfg. Co., Pittsburgh, Pa 655
Stacey Mfg. Co., Cincinnati, O 655
The Gas Machinery Co., Cleveland, O 636
Western Gas Construction Co., Fort Wayne, Ind 660

PRODUCER POWER PLANTS.

Economical Gas Apparatus Construc'n Co., Toronto, Ont. 651
R. D. Wood & Co., Philadelphia, Pa. 654

TAR AND CARBONIC ACID EXTRACTOR.

Economical Gas Apparatus Construc'n Co., Toronto, Ont. 651
Isbell-Porter Co., Newark, N. J 640
Kerr Murray Mfg. Co., Fort Wayne, Ind 653
Stacey Mfg. Co., Cincinnati, O 655
The Gas Machinery Co., Cleveland, O 636
Western Gas Construction Co., Fort Wayne, Ind 660

AMMONIA CONCENTRATORS.

Michigan Ammonia Works, Detroit, Mich 633
The Gas Machinery Co., Cleveland, O 636
Western Gas Construction Co., Fort Wayne, Ind. 660

GAS METERS.

American Meter Co., New York and Philadelphia. 659
Detroit Meter Company, Detroit, Mich 659
D. McDonald & Co., Albany, N. Y. 657
Helme & McIlhenny, Philadelphia, Pa 659
John J. Griffin & Co., Philadelphia, Pa 616
Keystone Meter Co., Royersford, Pa 658
Maryland Meter and Mfg. Co., Baltimore, Md 658
Metric Metal Co., Erie, Pa 659
Nathaniel Tufts Meter Co., Boston, Mass 658
New York Improved Meter Co., New York City 658
Pittsburg Meter Co., East Pittsburg, Pa 657
Rotary Meter Co., New York City 635

PREPAYMENT METERS.

American Meter Co., New York and Philadelphia..... 659
D. McDonald & Co., Albany, N. Y..... 657
Helme & McIlhenny, Philadelphia, Pa..... 659
John J. Griffin & Co., Philadelphia, Pa..... 616
Keystone Meter Co., Royersford, Pa..... 658
Nathaniel Tufts Meter Co., Boston, Mass..... 658
New York Improved Meter Co., New York City..... 658
Pittsburg Meter Co., East Pittsburg, Pa..... 656

PREPAYMENT METER ATTACHMENTS.

New York Improved Meter Co., New York City 658
Reeves Mfg. Co., New Haven, Conn. 655

WATER METERS.

Pittsburg Meter Co., East Pittsburg, Pa..... 657

GAS AND WATER PIPES.

Davis & Farnum Mfg. Co., Waltham, Mass..... 642
Donaldson Iron Co., Emaus, Pa..... 644
Economical Gas Apparatus Construc'n Co., Toronto, Ont. 651
R. D. Wood & Co., Philadelphia, Pa..... 654
Warren Foundry and Mach'ne Co., New York City..... 644

GAS COALS.

Berwind-White Coal Mining Co., New York and Phila. 650
Perkins Co., New York City..... 650
Westmoreland Gas Coal Co., Philadelphia, Pa..... 651

SPECIALTIES FOR OIL AND PIPE LINES.

S. R. Dresser, Bradford, Pa..... 638

GAS MAIN STOPPERS.

Safety Gas Main Stopper Co., New York City..... 644

MAIN AND SERVICE LAYING.

Sullivan Bros., Flushing, N. Y..... 653

GAS TAPPING MACHINES.

George Light, Dayton, O..... 644
H. Mueller Manufacturing Co., Decatur, Ills..... 639

CANNEL COALS.

Perkins & Co., New York City..... 650

STOKING MACHINERY.

G. A. Bronder, New York City..... 647

CONVEYORS.

Cruse-Kemper Co., Philadelphia, Pa..... 640
C. W. Hunt Company, New York City..... 641
Economical Gas Apparatus Construc'n Co., Toronto, Ont 651
G. A. Bronder, New York City..... 649
Kerr Murray Mfg. Co., Fort Wayne, Ind 653
The Gas Machinery Co., Cleveland, O..... 636
The Jeffrey Manufacturing Co., Columbus, O..... 650
Western Gas Construction Co., Fort Wayne, Ind..... 600

CHARGING BARROWS & COAL WAGONS.

Davis & Farnum Mfg. Co., Waltham, Mass..... 652
Kerr Murray Mfg. Co., Fort Wayne, Ind..... 653
Stacey Mfg. Co., Cincinnati, O..... 655

GAS ENRICHERS.

Standard Oil Co., New York City..... 651
The Sun Oil Co., Pittsburgh, Pa..... 651

COKE CRUSHERS.

C. M. Keller, Columbus, Ind..... 651
The Jeffrey Manufacturing Co., Columbus, O..... 650

GAS METER CONNECTIONS.

H. Mueller Manufacturing Co., Decatur, Ills..... 639

GAS COCKS.

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(*Continued on page 633.*)

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GAS AND ELECTRIC PROPERTIES.

(Concluded from page 632.)

GAS GAUGES.

The Bristol Co., Waterbury, Conn..... 141

GAS GOVERNORS.

Chaplin-Fulton Mfg. Co., Pittsburgh, Pa..... 641
Connelly Iron Sponge & Governor Co., New York City. 649
Isbell-Porter Co., Newark, N. J..... 640
Pittsburg Meter Co., East Pittsburg, Pa..... 657
R. D. Wood & Co., Philadelphia, Pa..... 654
Reynolds Gas Regulator Co., Anderson, Ind. 648

FUEL ECONOMIZERS.

Green Fuel Economizer Co., Matteawan, N. Y..... 641

CEMENTS.

C. L. Gerould, Pittsburgh, Pa..... 648

RETORTS AND FIREBRICKS.

Baltimore Retort and Firebrick Co., Baltimore, Md... 618
Gas Bench Construction Co., St. Louis, Mo. 618
Henry Maurer & Son, New York City..... 641
James Gardner, Jr., Co., Pittsburgh, Pa..... 648
J. H. Gautier & Co., Jersey City, N. J..... 648
Laclede Firebrick Mfg Co., St. Louis, Mo..... 649
Missouri Firebrick Co., St. Louis, Mo 648
National Pyrogravit Co., New York City..... 648
Parker-Russell Mining and Mfg. Co., St. Louis, Mo ... 637

INCLINED RETORTS.

Baltimore Retort and Firebrick Co., Baltimore, Md..... 618
Gas Bench Construction Co., St. Louis, Mo..... 618
Laclede Firebrick Mfg. Co., St. Louis, Mo..... 649
Parker-Russell Mining and Mfg. Co., St. Louis, Mo..... 637

VERTICAL S'S.

Connelly Iron Sponge & Gov. Co. (Drake's [Eng.] System) 649
Gas Bench Construction Co., St. Louis, Mo..... 618
Laclede Firebrick Mfg. Co., St. Louis, Mo..... 649
Parker-Russell Mining and Mfg. Co., St. Louis, Mo..... 637

REGENERATIVE FURNACES.

Baltimore Retort and Firebrick Co., Baltimore, Md..... 618
Bartlett, Hayward & Co., Baltimore, Md..... 653
Gas Bench Construction Co., St. Louis, Mo..... 618
J. H. Gautier & Co., Jersey City, N. J..... 648
Laclede Firebrick Mfg. Co., St. Louis, Mo..... 649
Missouri Firebrick Co., St. Louis, Mo..... 648
Parker-Russell Mining and Mfg. Co., St. Louis, Mo..... 637

SELF-SEALING MOUTHPIECE DOORS.

Continental Iron Works, Brooklyn, N. Y..... 654
Davis & Farnum Mfg Co., Waltham, Mass..... 652
Isbell-Porter Co., Newark, N. J..... 640
Kerr Murray Mfg. Co., Fort Wayne, Ind 653
Logan Iron Works, Brooklyn, N. Y..... 656
R. D. Wood & Co., Philadelphia, Pa..... 654
Stacey Mfg. Co., Cincinnati, O 655
The Gas Machinery Co., Cleveland, O..... 636
Western Gas Construction Co., Fort Wayne, Ind. 660

INCANDESCENT GAS LAMPS.

D. M. Steward Mfg. Co., Chattanooga, Tenn..... 590
General Gas Light Co., Kalamazoo, Mich..... 648
Geo. G. Ramsdell, New York City..... 638
Welsbach Company, Gloucester, N. J..... 646

BURNERS.

D. M. Steward Mfg. Co., Chattanooga, Tenn..... 590
Wm. M. Crane Co., New York City..... 638

LAVA GAS TIPS.

D. M. Stewar M'g. Co., Chattanooga, Tenn..... 590

STREET LAMPS.

Thos. T. W. Miner, New York City..... 644
Welsbach Street Lighting Co., New York and Phila... 646

PURIFIERS.

Connelly Iron Sponge & Governor Co., New York City.. 649
Cruse-Kemper Co., Philadelphia, Pa..... 640
Davis & Farnum Mfg. Co., Waltham, Mass 652
Isbell-Porter Co., Newark, N. J..... 640
Kerr Murray Mfg Co., Fort Wayne, Ind..... 653
R. D. Wood & Co., Philadelphia, Pa..... 654
Stacey Mfg. Co., Cincinnati, O..... 655
Western Gas Construction Co., Fort Wayne, Ind. 660

PURIFYING MATERIALS.

Connelly Iron Sponge & Governor Co., New York City.. 649

VALVES.

Continental Iron Works, Brooklyn, N. Y..... 654
Davis & Farnum Mfg. Co., Waltham, Mass..... 652
Economical Gas Apparatus Construc'n Co, Toronto, Ont 651
Isbell Porter Co., Newark, N. J..... 640
Kerr Murray Mfg. Co., Fort Wayne, Ind 653
Ludlow Valve Manufacturing Co., Troy, N. Y..... 641
R. D. Wood & Co., Philadelphia, Pa..... 654
Stacey Mfg. Co., Cincinnati, O..... 655
The P. H. & F. M. Roots Co., Connersville, Ind..... 643
Western Gas Construction Co., Fort Wayne, Ind..... 660

EXHAUSTERS.

Connelly Iron Sponge & Governor Co., New York City.. 649
Connersville Blower Co., Connersville, Ind..... 642
Davis & Farnum Mfg. Co., Waltham, Mass..... 652
Isbell-Porter Company, Newark, N. J..... 640
Kerr Murray Mfg. Co., Fort Wayne, Ind..... 653
The P. H. & F. M. Roots Co., Connersville, Ind..... 643

PURIFIER AND SCRUBBER TRAYS.

Cabot Mfg. Co., Hoboken, N. J..... 651
Western Gas Construction Co., Fort Wayne, Ind..... 660

GAS STOVES.

American Meter Co., New York and Philadelphia..... 659
Keystone Meter Co., Royersford, Pa..... 658
Maryland Meter & Manufacturing Co., Baltimore, Md.. 658
Nathaniel Tufts Meter Co., Boston, Mass..... 658

HOT WATER HEATERS.

Humphrey Co., Kalamazoo, Mich..... 641

GASHOLDER TANKS.

J. P. Whittier, Brooklyn, N. Y..... 644

GASHOLDERS.

Bartlett, Hayward & Co., Baltimore, Md..... 653
Continental Iron Works, Brooklyn, N. Y..... 654
Cruse-Kemper Co., Philadelphia, Pa. 640
Davis & Farnum Mfg. Co., Waltham, Mass,..... 652
Deily & Fowler, Philadelphia, Pa..... 656
Economical Gas Apparatus Construc'n Co., Toronto, Ont 651
Kerr Murray Mfg. Co., Fort Wayne, Ind..... 653
Logan Iron Works, Brooklyn, N. Y..... 656
R. D. Wood & Co., Philadelphia, Pa..... 654
Riter-Conley Mfg Co, Pittsburgh, Pa..... 655
Stacey Mfg. Co., Cincinnati, O..... 655
Western Gas Construction Co., Fort Wayne, Ind..... 660

STORAGE TANKS.

Davis & Farnum Mfg. Co., Waltham, Mass..... 652
Stacey Mfg. Co., Cincinnati, O..... 655
Western Gas Construction Co., Fort Wayne, Ind..... 660

PAINTS.

American Standard Composition Co., New York City.. 652

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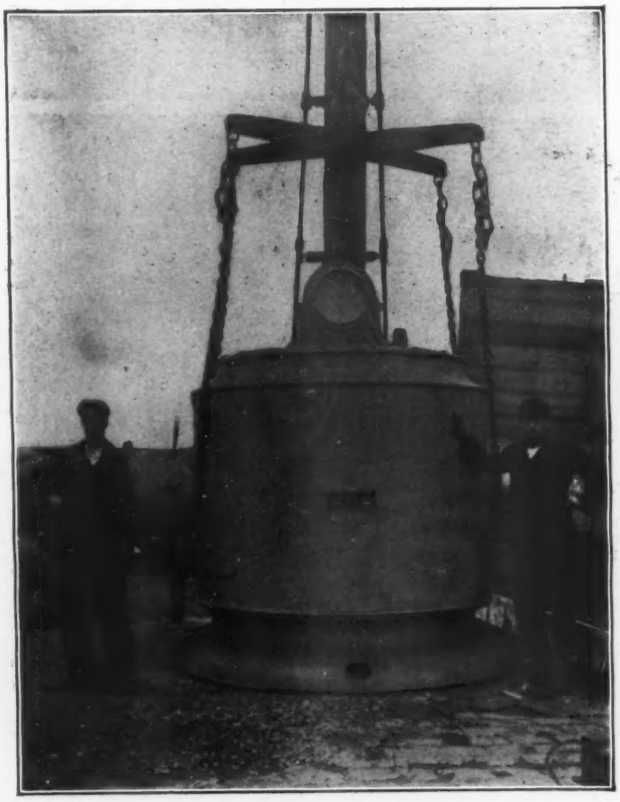

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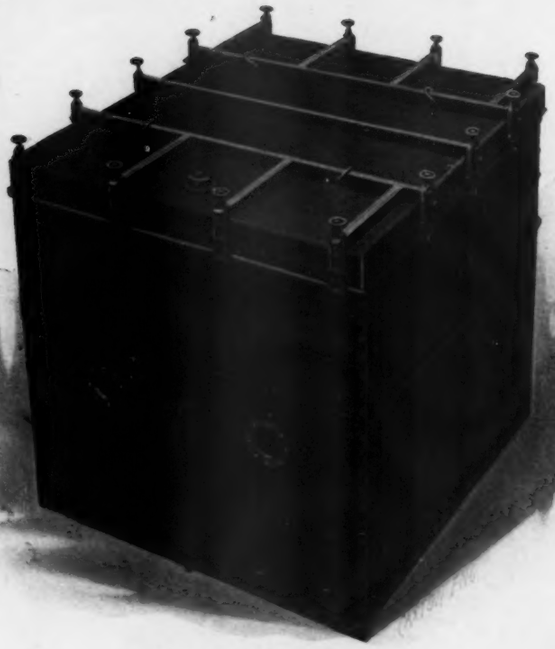

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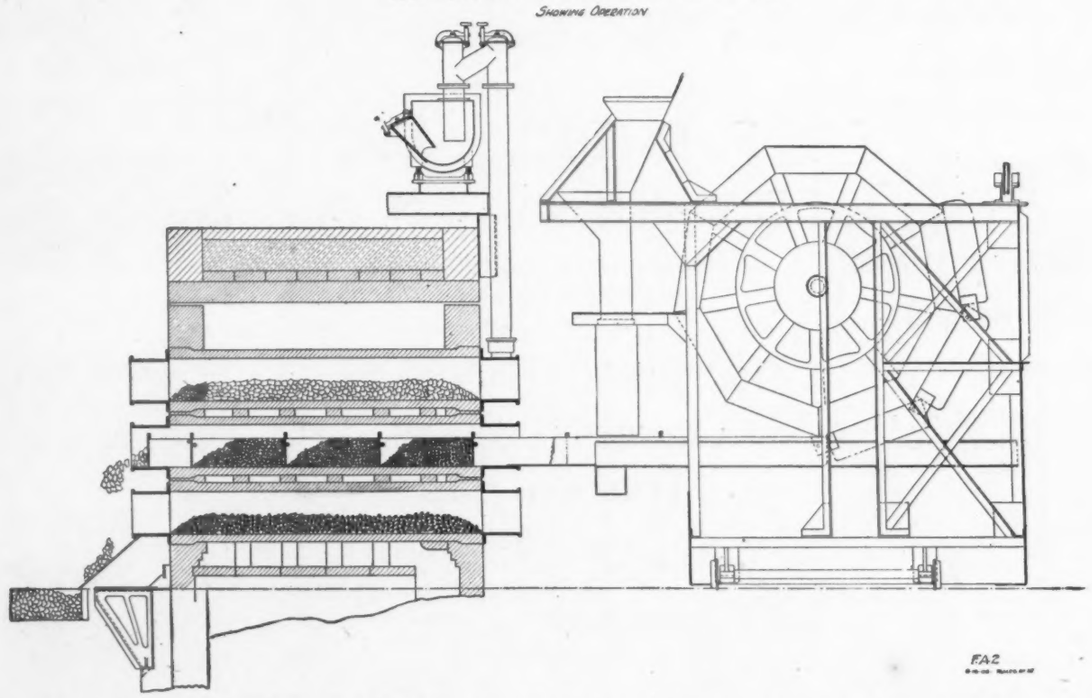

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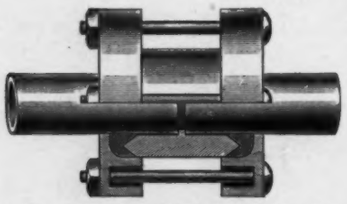
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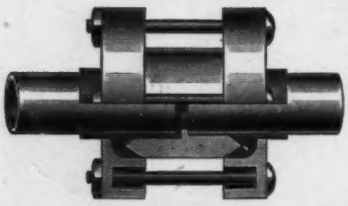
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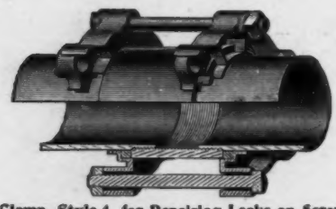
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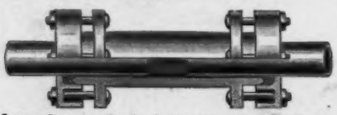
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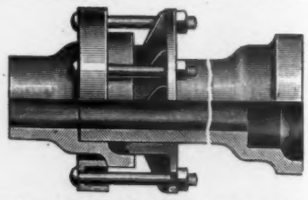
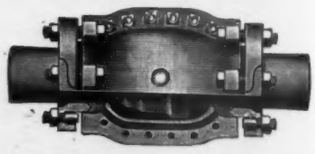
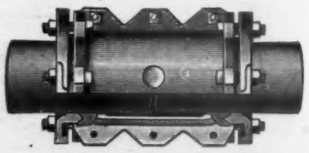
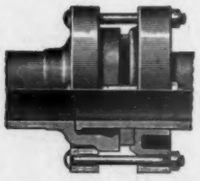

Coupling, Style 9, for Special Style Cast Iron Pipe.


Split Sleeve for Repairing Broken Bell or Cast Iron Pipe.


Split Sleeve for Repairing Broken or Cracked Cast Iron Pipe.


Clamp, Style 4½, for Repairing Leaky Lead or Cement Joints in Cast Iron Pipe.

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For outdoor or indoor use; made in five sizes—one-light to five-light. The "Ramsdell" is the only Inverted Arc manufactured. Everything about it is of the same high quality that has made the "Ramsdell" the standard among inverted lamps.

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List prices range from $8.75 to $24.

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LOCK-WING METER COCK.

C—1175.

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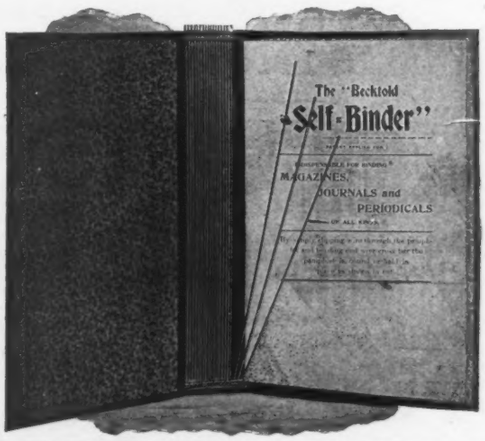

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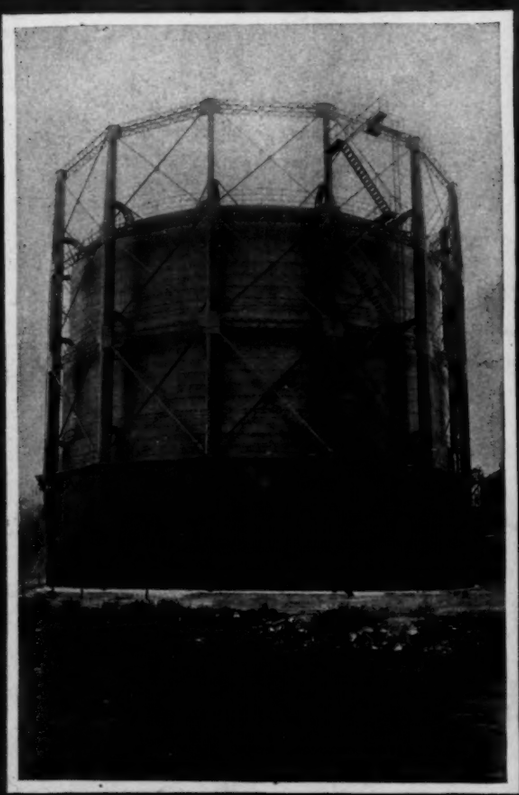

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WITH OR WITHOUT
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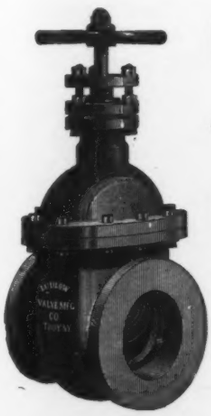

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Double and Single Gate Valves, ¼" to 72",

—FOR—

Gas, Water, Steam, Oil, Ammonia, Etc.

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—(ALL RANGES).—

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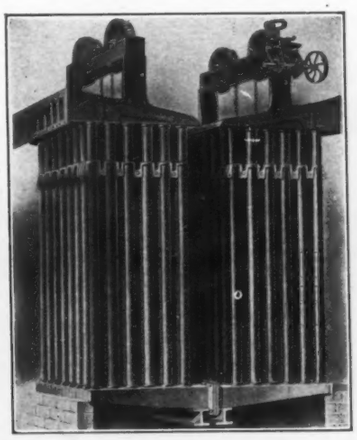

HOW MUCH COAL PER 1,000 CU. FT. OF WATER GAS?

If the process of making water gas were theoretically perfect, only 24 lbs. of coal would be consumed per 1,000 cu. ft. of gas generated. As a matter of fact, the actual figures are between 40 and 48 lbs. per 1,000 cu. ft. It is apparent that there is a waste somewhere, and if you will take the trouble to put a thermometer over the stack valve during the "blowing up" period, you will see where the heat goes to. From one-third to one-half of the heat escapes to the atmosphere, either as sensible heat or latent heat of combustion. If use can be found for this heat a great economy could be effected immediately.

We have found such a use. By means of the Green Air Heater 12 per cent. to 15 per cent. of this heat, or more, can be imparted to the air blown to the generator. This will reduce the time for blowing up and increase the temperature of the generator, so that about the same proportion of coal will be saved.

After the gases have passed through the air heater they are still hot enough to use in a Green Fuel Economizer to heat the boiler-feed water up to the evaporative point. In In this way a quarter of the boiler coal can be saved. In connection with a 6-ft. generator an investment of $3,500 in an Air Heater and an Economizer will save from $2,300 to $2,500 per year. This ought to repay you for the trouble of writing us for further information. Ask for Circular "AG."

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MATTEAWAN, N. Y.

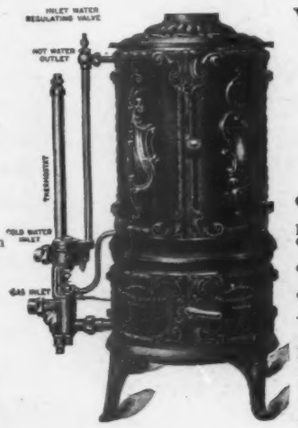
(Sole builders of the Green Fuel Economizer in this country; we also build Fans and Blowers.)

These heaters differ in size only.

The 3-A is suitable for one bathroom, kitchen and laundry.

The 4-A is suitable for two bathrooms, kitchen and laundry.

The 6-A is suitable for two or three bathrooms, kitchen, laundry and additional lavatories.



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HUMPHREY AUTO-THERMAL PRESSURE WATER HEATERS,

The Most Perfect Water Heaters of the Kind on the Market.

SOME EXCLUSIVE FEATURES.

1. The smallest pilot light in the world.
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3. An external thermostat, the most sensitive and positive. It cannot be superheated by the pilot light or hindered by lime. It insures safety, economy and reliability.
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5. Simplest Automatic Valve ever made; can't get out of order.

LIBERAL DISCOUNTS.

GUARANTEE.

When these heaters are connected exactly as directed on the card of instructions sent with each heater—and are supplied with gas testing 650 heat units—

We guarantee that the Humphrey Heater will raise 1 gallon of water 63° F for every cubic foot of gas burned.

We guarantee each heater for 1 year, perfect in operation, construction, material and workmanship.

☞ *It is our wish to satisfy each customer and we make every effort to this end.*

No. Heater.	Price	Gas Supply from Meter.	Heats Gallons per Minute 50° in Temperature	Height Inches.	Diameter Inches.	Shipping Weight.
3-A	$85 00	1 In.	4	40	14	30 Lbs.
4-A	100,00	1 In.	4½	45	16	325 "
6-A	130,00	1½ In.	6	48	22	375 "

Handsome new Catalog No. 10 mailed anywhere on request to

HUMPHREY COMPANY,

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Maximum Efficiency,
Minimum Back Pressure,
Complete Safety.

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WHY DO GAS EXHAUSTERS

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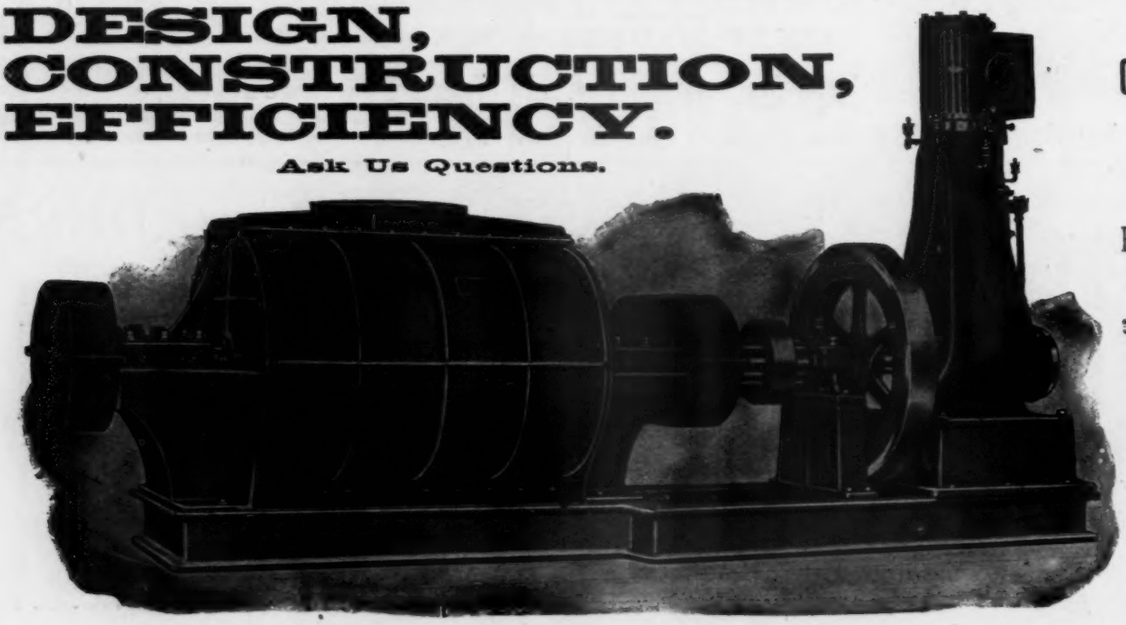
Stand so High in the estimation of those using them?

THE ANSWER IS IN THREE WORDS:

DESIGN, CONSTRUCTION, EFFICIENCY.

Ask Us Questions.



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Write us about our Improved Stuffing Boxes.

Something Entirely New.

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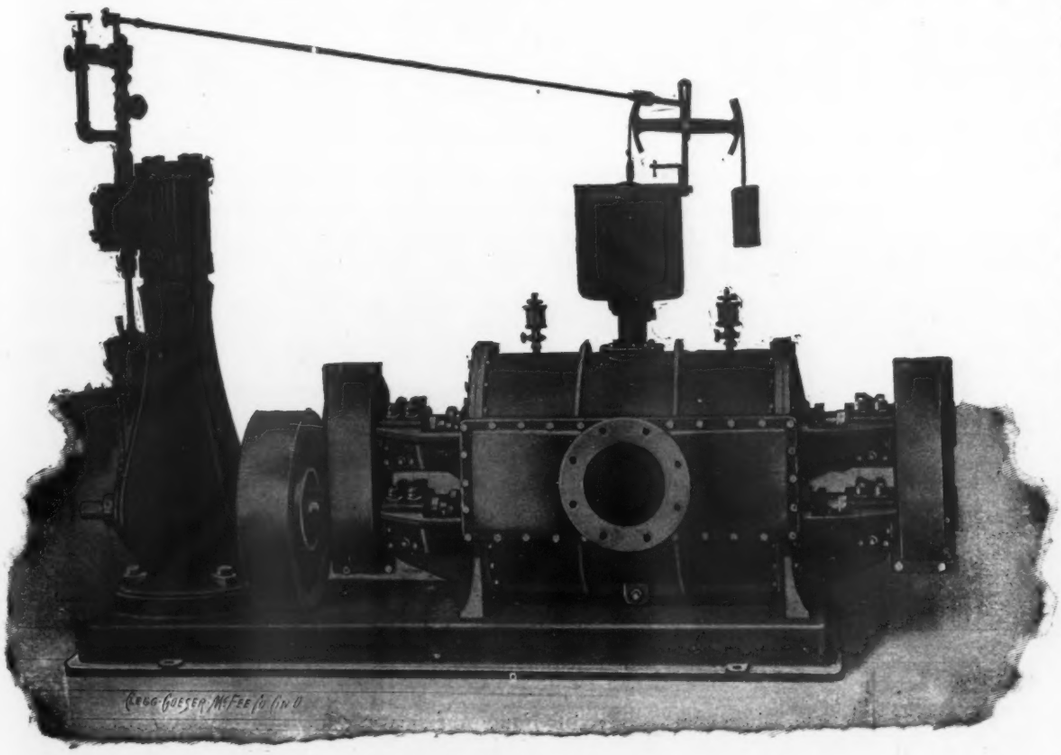

Sizes for any required capacity.

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Most perfect and sensitive Governor.

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WORK IN THE OPEN.

Show the public that there's an enterprising Gas Company in town.

Help all branches of the business.

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FOR WATER AND GAS.

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GAS TAPPING MACHINES

—FOR—

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WITHOUT ANY ESCAPE OF GAS.

They are Strong and Compact.

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Machines Sent to any Gas Company for Thirty Days' Trial.

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Globe Street and Boulevard Lamps.

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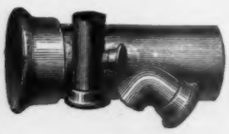

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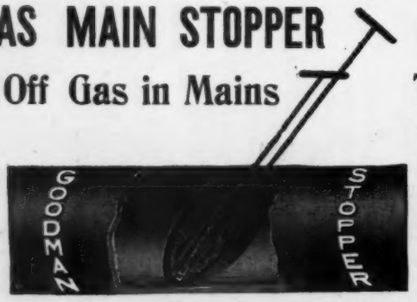
FROM THREE TO FORTY-EIGHT INCHES DIAMETER. ALSO, ALL SIZES OF

Flange Pipe for Sugar House and Mine Work. Branches, Bends, Retorts, etc., etc.

SAFETY GAS MAIN STOPPER COMPANY,

For Shutting Off Gas in Mains

Any size gas main can be shut off in 30 seconds. : : :



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Chollar's System of Gas Purification.

THE PURIFIED GAS REVIVES THE FOULED OXIDE.

Practical Handbook on

GAS ENGINES,

With Instructions for Care and Working of the Same,

By G. LIECKFELD, C.E.

Translated with Permission of the Author, By GEO. M. RICHMOND, M.E.

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No. 42 Pine Street, - - New York City.

Do You Wish to Know

what size of pipe to use to convey any quantity of gas, any distance, with any loss of pressure and any initial or final pressure? Then use

Cox's Gas Flow Computer,

as it gives this information accurately at sight, without mental effort. No calculations needed. Saves time, money and mistakes.

Price, 6.5 x 8 inches, in cloth case, $2.50.
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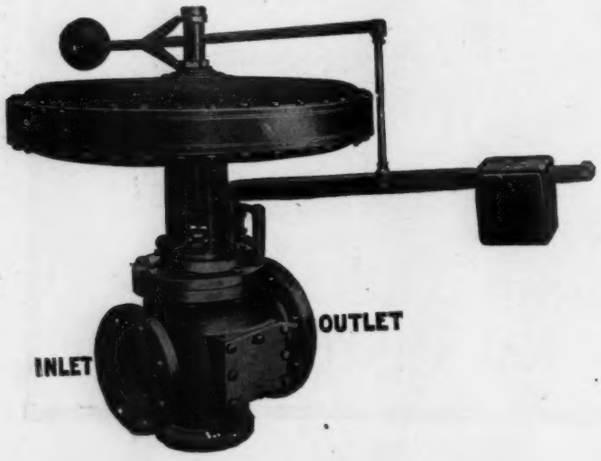

THE FULTON GAS PRESSURE GOVERNOR,

WITH AUTOMATIC SAFETY CUTOFF.

For Artificial or Natural Gas.
For District or Service Use.

Our DUPLEX SENSITIVE GOVERNOR, with Automatic Cutoff for district service, will reduce high pressure gas to inches of water without variation.

Absolutely safe and reliable. No complicated mechanism to get out of order. More than 20 years' experience with the largest gas companies.

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AMERICAN METER CO.,

NEW YORK, ST. LOUIS, PHILADELPHIA, SAN FRANCISCO, CHICAGO,

Photometrical and Experimental Apparatus.

PUBLIC LIGHTING TABLE.

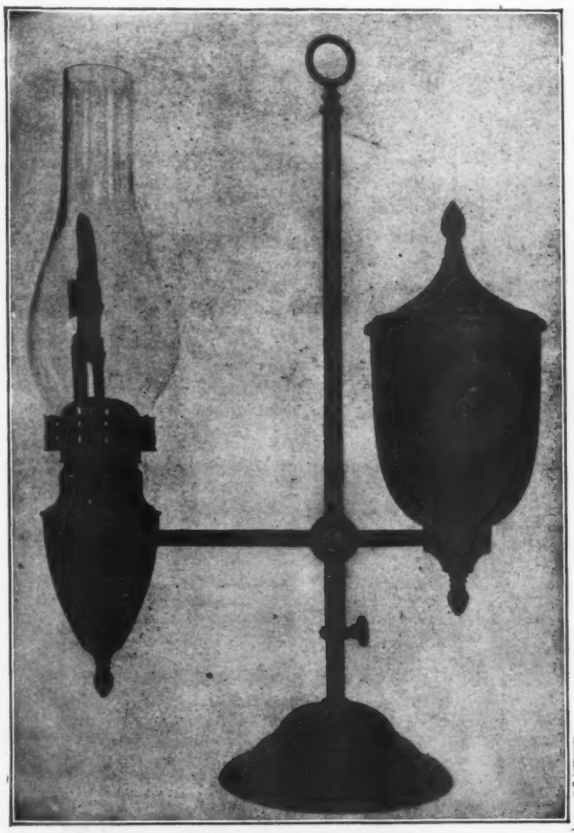
MAY, 1907.

Day of Week.	Table No. 1. Following the Moon. Date.	Light.	Extinguish.
Wed.	1	7.20 PM	12.00 PM
Thu.	2	7.20	1.00 AM
Fri.	3	7.20	1.50
Sat.	4	7.20 LQ	2.40
Sun.	5	7.30	3.20
Mon.	6	7.30	3.50
Tue.	7	7.30	3.50
Wed.	8	7.30	3.50
Thu.	9	7.30	3.50
Fri	10	7.30	3.50
Sat.	11	7.30 NM	3.50
Sun	12	7.40	3.50
Mon.	13	7.40	3.50
Tue.	14	7.40	3.50
Wed.	15	7.40	3.50
Thu.	16	10.00	3.50
Fri.	17	10.40	3.50
Sat.	18	11.20	3.50
Sun.	19	12.00	3.40
Mon.	20	12.30 AM FQ	3.40
Tue.	21	1.00	3.40
Wed.	22	1.30	3.40
Thu.	23	2.00	3.40
Fri.	24	2.30	3.40
Sat.	25	3.10	3.40
Sun.	26	No L.	No L.
Mon.	27	No L FM	No L.
Tue.	28	No L.	No L.
Wed.	29	7.50 PM	10.50 PM
Thu.	30	7.50	11.50
Fri.	31	7.50	12.40 AM

TOTAL HOURS DURING 1907.

By Table No. 1.

	Hrs.Min.
January	211.10
February	193.40
March	182.10
April	167.00
May	157.00
June	145.30
July	151.50
August	162.30
September	175.30
October	202.40
November	209.30
December	231.50
Total, yr.	2190.20



THE ELLIOTT KEROSENE STANDARD PHOTOMETER LAMP.

***

10-Candle Power.

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This lamp is a perfect substitute for the 10-candle Pentane Lamp hitherto used, and has the following advantages:

1st. It uses Standard Kerosene Oil (Pratt's Astral Oil or equivalent).

2d. It is remarkably steady. Will burn 24 hours continuously with less than 2 per cent. variation.

3d. It is much less dangerous than Pentane, which is a kind of gasolene.

4th. It is not easily affected by air currents in the photometer room.

5th. Since the lamp may burn continuously, the candle power of gas may be taken at any moment, if necessary. This insures steady illuminating power without waste of carburetting material.

6th. The first cost of the lamp brings it within the reach of even small gas works.

7th. Costs much less to maintain than a Pentane lamp or sperm candles doing the same service.

8th. Is not affected by the weather.

PUBLIC LIGHTING TABLE.

MAY, 1907.

Day of Week.	Table No. 2. New York City. All Night Lighting. Date.	Light	Extinguish.
		P. M.	A.M.
Wed.	1	6.45	4.00
Thu.	2	6.45	4.00
Fri.	3	6.45	4.00
Sat.	4	6.45	4.00
Sun.	5	6.45	4.00
Mon.	6	6.45	4.00
Tue.	7	6.55	3.40
Wed.	8	6.55	3.40
Thu.	9	6.55	3.40
Fri.	10	6.55	3.40
Sat.	11	6.55	3.40
Sun.	12	6.55	3.40
Mon.	13	6.55	3.40
Tue.	14	7.00	3.30
Wed.	15	7.00	3.30
Thu.	16	7.00	3.30
Fri.	17	7.00	3.20
Sat.	18	7.00	3.30
Sun.	19	7.00	3.30
Mon.	20	7.00	3.30
Tue.	21	7.10	3.15
Wed.	22	7.10	3.15
Thu.	23	7.10	3.15
Fri.	24	7.10	3.15
Sat.	25	7.10	3.15
Sun.	26	7.10	3.15
Mon.	27	7.10	3.15
Tue.	28	7.15	3.15
Wed.	29	7.15	3.15
Thu.	30	7.15	3.15
Fri.	31	7.15	3.15

TOTAL HOURS DURING 1907.

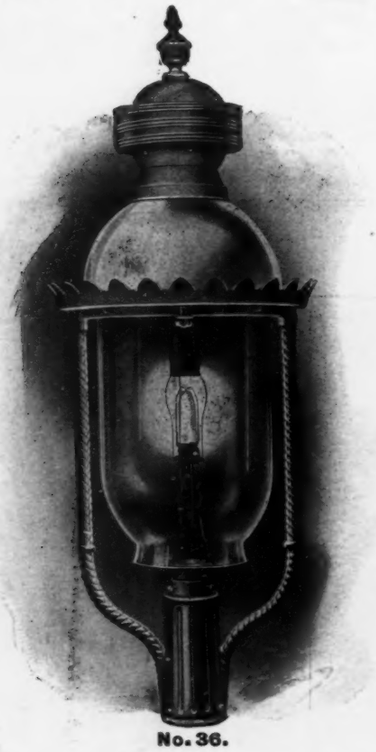
By Table No. 2.

	Hrs.Min.
January	423.20
February	355.25
March	355.35
April	298.50
May	264.50
June	234.25
July	243.45
August	280.25
September	321.15
October	374.30
November	401.40
December	433.45
Total, yr.	3987.45

NEW YORK, 318 West 42d Street. BOSTON, 820 Beacon Building. PHILADELPHIA, Broad and Arch Streets. ST. LOUIS, 712 Roe Building. CHICAGO, 218 La Salle Street. SAN FRANCISCO, 512 Oak Street.

WELSBACH STREET LIGHTING COMPANY

....OF AMERICA....



No. 36.

Controls and Operates the **Welsbach System of Street Lighting,**

Which includes its specially DESIGNED and PATENTED BURNER for PARK LIGHTING exclusively.

Uniformly SUCCESSFUL in 150 Cities and Towns.

By means of the Welsbach System of street lighting the superiority of GAS over electricity for street lighting has been fully demonstrated.

POINTS OF MERIT:

It is { Economical, Attractive, Successful, Up-to-date.

IT LIGHTS THE STREET.

Where there are no gas mains we can furnish an equally good light by our SELF-GENERATING NAPHTHA WELSBACH BURNER, and thereby supply a uniform light in all localities.

Correspondence Solicited from Gas Companies and Others interested in Municipal and Outside Lighting.

No. 38.

INVERTED REFLEX TRADE MARK GAS LIGHT

Succeeds and Excels the Electric Light at One-Quarter the Cost.

THE BURNER.

Elegance of Appearance.
Best Possible Material and Workmanship.
Perfect Combustion.
Lowest Gas Consumption.
Highest Candle Power.
Will Fit Any Fixture.
Will Not Flash Back.
Will Not Blacken Mantles.
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THE MANTLE.

Best Welsbach Quality.
Extra Strong and Durable.
Highest Maintained Candle Power.
Rich Mellow Light.

THE GLASSWARE.

Highest Quality Imported.
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Protection from the Falling of Heated Particles.
Increases Candle Power.

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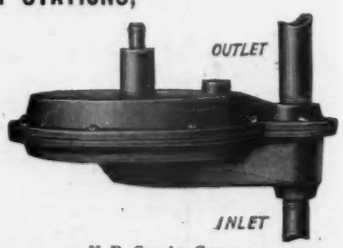

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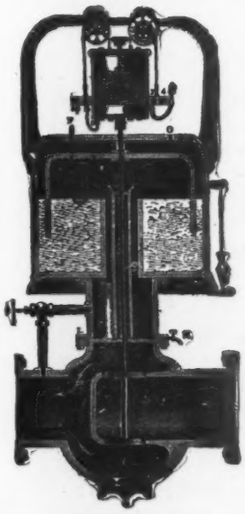

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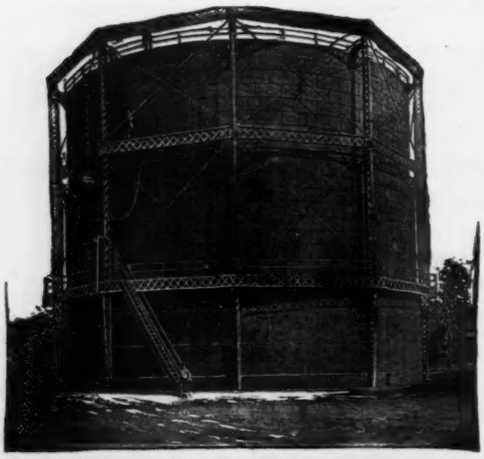

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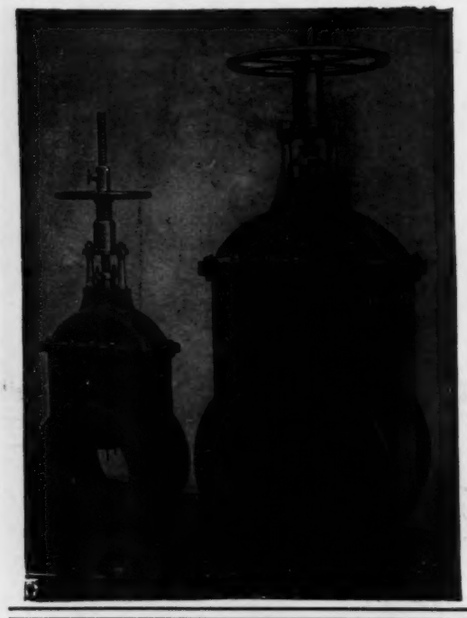

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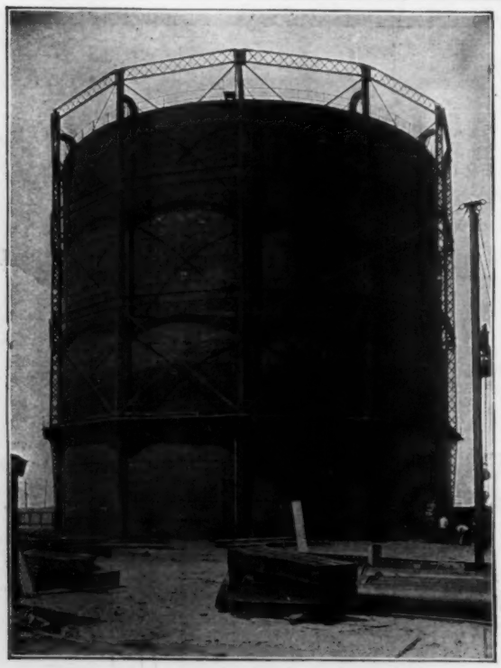

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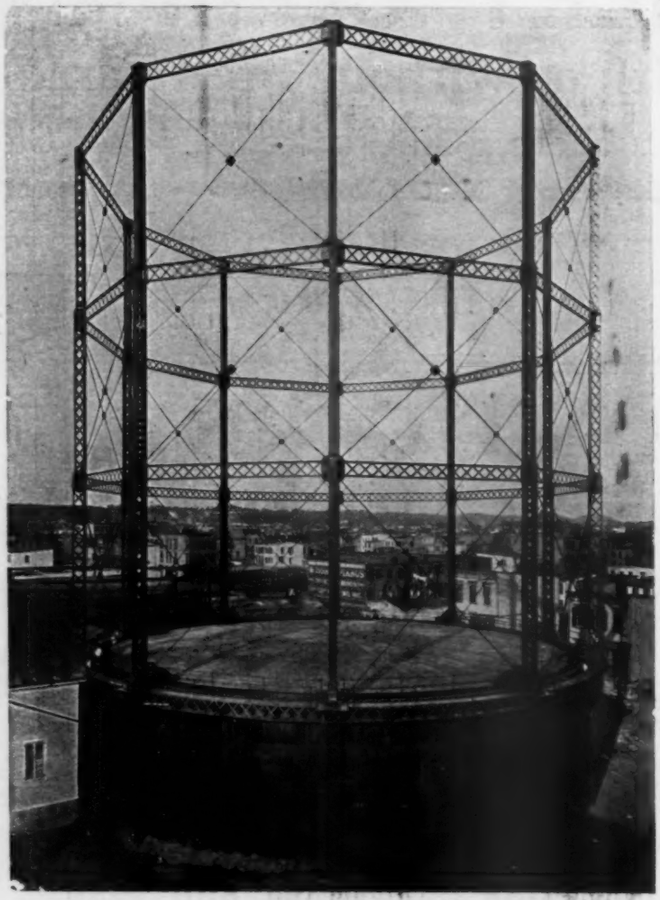

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